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## FOREWORD

ACUTE controversy exists between economic thinkers regarding the efficacy of planned economy in realizing the ends which such economy is supposed to achieve. On the one hand we have thinkers such as Mises, Hayek and Robbins who have emphasized the difficulty of having rational calculations on which planned economy can be based. Lerner and Oscar Lange have however shown that this can be done. In view of the recent trend towards planned economy, it should be of interest to all concerned to develop this line of thought and formulate a theory of pricing in planned economy. In making this effort, Krishnamurti has carefully followed the recent contributions of Hotelling, Hicks, and Allen. He discusses the place of the price system in a planned economy and comes to the conclusion 'that guidance of productive activity on the strict *marginal* principle brings about the most *economic* utilization of communal resources through an effective functioning of the pricing process. The marginal technique however breaks down in the analysis of lumpy units; and in all such instances, recourse must be had to another technique on the lines of Dupuit to provide an adequate, measurement of social cost and benefit.'

This work was first done as a Ph.D. thesis in this school. Thanks are due to Mr Maurice Dobb who on an appreciative report on the thesis made valuable suggestions. These have been taken into account in revising the work for publication. In a few cases, however, it has been decided to write additional chapters in a future edition. So far as the quality of the work is concerned, I cannot do better than quote the words of Mr Maurice Dobb: 'In this work the author displays a keen sense of relevance, a grasp

of essentials, and a capacity for handling the tools of economic analysis and for lucid and cogent exposition. One can see evidence in it of a mind of distinction; as the first work of a young economist I think it can be said to show promise that its author will develop into a thinker who is capable of making a major contribution to his subject.'

C. N. VAK

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7 March 1949*

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## THE PROBLEM

ADAM Smith advanced the great principle of *laissez-faire* after a detailed study of the economic environment of his time. Agriculture was still the dominant economic activity. Small-scale production was the characteristic feature of industrial enterprise. In general, all productive activity was subject to increasing marginal costs of production. In the context of his age, Adam Smith's principle was the most effective method of bringing about the maximum economic efficiency and welfare of the community. Under universal conditions of rising marginal costs, freedom of enterprise, along with free choice for the individual in consumption and employment, ensures both the stability of economic equilibrium and the maximum net advantage to the community. The *laissez-faire* principle rests on the assumption of rising marginal costs.

But the economic progress of the last two hundred years has made this assumption woefully obsolete. The industrial advancement in modern communities, particularly in the West, has radically transformed the system of production. A large part of economic activity is undertaken by large-scale enterprises, either private or public. Over a wide sector of economic activity, production is carried on under conditions of falling marginal costs. As such, atomistic competition has proved not merely ineffective but positively obstructive in attaining the position of maximum net advantage to the community.

The failure of atomistic competition in bringing in the best of everything was realized by Alfred Marshall, who clearly recognized the incompatibility of increasing returns with free competition. Professor



Pigou in his standard treatise on the subject *The Economics of Welfare* has tackled the complications introduced by increasing returns in studies of economic welfare. And the time has now come for a clear recognition of the fact that the competitive criterion has lost its significance in welfare studies owing to the changed conditions of production. The problem of maximum utilization of the productive resources of the community has to be analysed as an independent all-important problem, stripped of all its historical associations with the framework of free enterprise. The object of this study is to attempt a systematic analysis of this problem.

'Planned Economy' provides the theoretical framework in which this problem of maximizing the net economic advantage of the community under modern conditions of production could be effectively analysed. It is essential for the analytical purposes of this study to admit the possibility of regulating the economic system in a conscious manner. And it is just in this sense that the term 'Planned Economy' is introduced. The reorientation consists in approaching the fundamental economic problem of the modern community from the end of *planning*, the exact opposite of the traditional *free enterprise*. By its very definition, planning is necessitated to a greater extent in communities which are technologically advanced.

For the purposes of this study, free enterprise within a planned economy is restricted to those spheres wherein production is subject to rising marginal costs. This is natural since any intervention in the form of planning is thoroughly unnecessary in such spheres. But the productive activity of the community is viewed as an integrated whole subject to unified control.

The fundamental economic problem is merely the problem of choice. In this respect the problem is universal. Harrod has well pointed out that satisfaction of preferences has constituted the *economic criterion* right from the days of Adam Smith.<sup>1</sup> Given

<sup>1</sup> R. F. Harrod, "Scope and Method of Economics", *E. J.*, Vol. XLVIII, pp. 389-97

a system of preferences, selection of alternatives to the maximum net advantage is rendered possible for every individual by the existence of the price system. A full knowledge of the terms on which alternatives are offered is essential for any rational exercising of choice. This knowledge is obtained through the price-mechanism. Prices, in the fundamental sense, are 'the terms on which alternatives are offered'. Wicksteed has lucidly distinguished this fundamental sense of the term from its narrow sense of 'exchange-ratios of two commodities on a market'. Prices in the narrow sense of 'the money for which a material thing, a service or a privilege can be obtained'<sup>1</sup> is simply a particular manifestation of its fundamental sense, applied to a particular institutional framework. Viewed in this manner, the price system is an essential part of any economic system.

The price system has been historically grafted into the structure of the capitalist market with its incentive of private profit. This is understandable so long as economic analysis is restricted to the study of free enterprise. The individualist exchange economy with its markets as the business nexus rests basically on price-mechanism. But this does not in any way necessitate the dependence of the latter on the former. If free enterprise is replaced by a planned economy, the basic nature of price-mechanism is unaffected though the structure built upon it by the individualist society is erased.

The price system in a planned economy has the single purpose of providing the basis for the free exercising of individual choice. This applies to products as well as the factors of production. Prices are the objective indices guiding the subjective decisions of each individual that exercises choice and the quantitative decisions of each productive unit that undertakes production. This *parametric function of prices* in a planned economy is excellently demonstrated by

<sup>1</sup> P. H. Wicksteed, *The Common Sense of Political Economy*, Vol. I, p. 28.

Oscar Lange,<sup>1</sup> who has also described the actual working of the trial and error method in such an economy. This study takes his work as the starting point.

An important set of ideas has grown during the last twenty years in the process of refuting the criticisms advanced by Ludvig von Mises, F. von Hayek and Lionel Robbins regarding the impracticability of economic calculation in a socialist community.<sup>2</sup> In particular A. P. Lerner and Oscar Lange have developed the line of thought which this study undertakes to carry forward.

The central idea of this study is that guidance of productive activity on the strict *marginal* principle brings about the most *economic* utilization of communal resources through an effective functioning of the pricing process. The marginal technique however breaks down in the analysis of lumpy units ; and in all such instances, recourse must be had to another technique on the lines of Dupuit to provide an adequate measurement of social cost and benefit. The importance of this marginal concept in welfare studies is familiarized to all students of this subject by the standard work of Professor Pigou. After that work, the most outstanding contribution to this subject is Professor Harold Hotelling's article published in *Econometrica*.<sup>3</sup> Professor Hotelling has conclusively demonstrated that the 'optimum general welfare corresponds to the sale of everything at marginal cost'.

In constructing a compact theory of pricing in planned economy, this work has tried to knit together the relevant portions in the recent developments of the theory of value. The main fount from which ideas are drawn for this specific object consists of the writings of J. R. Hicks<sup>4</sup> and R. G. D. Allen,<sup>5</sup> not to mention Professor Hotelling's writings. References

<sup>1</sup> Oscar Lange, "On Economic Theory of Socialism", R. E. S., Vol. IV, pp. 57-71.

<sup>2</sup> For a detailed bibliography on the discussion, see H.D. Dickinson, *Economics of Socialism*.

<sup>3</sup> Harold Hotelling, "The General Welfare in Relation to Problems of Taxation and of Railway and Utility Rates", *Econ.*, Vol. VI, pp. 242-59.

<sup>4</sup> J. R. Hicks, *Value and Capital*.

<sup>5</sup> R. G. D. Allen, *Mathematical Analysis for Economists*.

to their work in the course of this study are too scanty an indication of the extent to which their ideas are made use of.

Institutional considerations are abstracted from this study, though planning implies that 'certain new relations, and hence new possibilities, will emerge, in the shape of a *new type of social organization*'.<sup>1</sup> The reason is that for constructing a theoretical system of planned economy, such a course would be of great help. The *economic* issues can be carefully analysed so that the extent to which the purely *economic* ideal is modified due to the institutional set-up can be estimated. In doing so, one is only following the line of the pure theorists who have developed the analysis of perfect competition. Just as this analysis has been extended to include the more realistic problems of market imperfection and oligopoly, in a similar manner it would be possible to tackle the actual problems of planning that have relevance only to a particular institutional order, once a general framework of planned economy is clearly set up. It would thereby become possible to measure the degree of departure of any actual planned system from the position of optimum general welfare. It is obvious that any such theoretical analysis can acquire meaning only when it is proved to be capable of being extended to the study of actual problems of planning. Institutional considerations are only abstracted for purely analytical convenience.

The controversy relating to the foundations of welfare economics does not present any obstacle for this study. The modern theory of value has dispensed with the *ordinal* measurement of utility. The only *welfare* assumption that is needed for this study is that there exist equal opportunities for all individuals of the community to exercise free choice. The distribution of the money incomes among the members of the community need only satisfy the condition that no individual exercises greater pull over the market

<sup>1</sup> Maurice Dobb, *Political Economy and Capitalism*, p. 320.

than the rest on account of a higher money income. Equal division of the money incomes is the simplest method of satisfying this condition. The stress is however not on equal money incomes but on equal opportunities for all individuals to exercise choice.

An important assumption retained till the last chapter is that individual money incomes are entirely spent away on consumption. This means that the volume of savings out of the annual national income is decided by a Planning Authority. This assumption is necessary to eliminate the complications introduced by money and to reduce the function of money merely to a *numeraire*. The rate of net new investment is decided by the Planning Authority. Corporate savings has a distinct advantage for this purpose. Full employment of resources can be maintained under conditions of economic progress by a proper regulation of the rate of net new investment. *Ex Ante* Savings would always be made equal to Investment.

But a consistent application of the principle of choice must include the time-preferences of the consumers. This means, logically, that even in a planned economy *individual* savings must finance new investment. For analytical purposes, this means an integration of the modern monetary theory with the pricing theory of a planned economy. Oscar Lange has made significant suggestions in this direction. This problem is discussed in the last chapter of this study.

In Chapter II the strict *economic* argument for free choice in consumption is distinguished from the wider issue of consumers' sovereignty. It is pointed out that in a planned economy there exists a sector of free goods in addition to the goods offered in the market. Relevant portions of the theory of consumer's choice are presented to demonstrate that a free market for consumers' goods ensures both optimum satisfaction to the individual and optimum allocation of consumption goods.

<sup>1</sup> Oscar Lange, "Review of Dickinson's *Economics of Socialism*", *J. P. E.*, Vol. L, pp. 302-3

Chapter III examines the crucial problem of planned economy viz. the optimum allocation of productive resources of the community. The marginal principle is systematically developed and a detailed proof of Professor Hotelling's fundamental propositions relating to general welfare is given. It is conclusively proved that maximum general welfare implies pricing all goods and services at their marginal costs of production.

The problem of the firm is taken up in Chapter IV. A firm is defined as a production unit where a good or goods are produced by the application of variable factors over a given stock of fixed equipment. In this chapter the stock of fixed equipment is taken as given and the conditions for the production of an *ideal* output are laid out.

In Chapter V the problem of the firm is continued. The important problem of determining the size of the fixed equipment is taken up at length. The concept of the minimum average cost is first examined and then replaced by the more fundamental criterion of maximum net benefit. The interesting problems relating to marginal-cost-pricing, rent, standardization and product differentiation are discussed.

Chapter VI is devoted to the study of large-scale enterprises. The distinction between the maximum net benefit criterion and the total revenue criterion is clearly brought out here. The importance of large-scale enterprises in the interests of maximum general welfare is discussed.

The study ends up with some concluding notes in Chapter VII on the nature of assumptions made at the beginning of the study relating to wage payments, investment and savings. The treatment is extremely cursory and only indicates the nature of the difficulties. At the end of this chapter the limitation of this study is stated and the lines for further study are indicated.

## CHOICE OF CONSUMPTION

**THE** individual consumer is the most significant economic unit in any system of economy. In a planned economy which forms the scope of this study, freedom of choice for the individual is considered to be an essential requisite. This freedom is ensured by the existence of a consumer's market wherein the individual can freely expend his entire money income in the purchase of goods and services he wants.

## i

The case for the consumer's choice is often linked up with the wider problem of the consumer's sovereignty. There has been a lively controversy on this wider problem in recent years. A free market in consumption goods and services is viewed as the economic counterpart of the political institutions of democracy. It is argued that the individual must be at liberty to exercise the choice also in economic affairs of his life. A defence of the consumer's choice on these grounds essentially involves a judgement of values and therefore does not readily lend itself to strict logical analysis. Anyway this much is obvious that in the existing individualist systems the average consumer enjoys this freedom in a rather restricted manner. 'The masses have dangled before their eyes the illusion of free choice—freedom to have what they want if they have the money—and are then handed over to the rack devised for them by the advertising agent, the commercial salesman, and the social conventions of a ruling class'.<sup>1</sup> There is plenty to be said on each of these points, but it is wholly unnecessary in the context of this

<sup>1</sup> Maurice Dobb, "Economic Theory and Socialist Economy, A Reply", *R. E. S.*, Vol II, p 147

study since all these factors that distort the free choice of consumption are unique to the individualist systems. In a planned economy it is consistent to assume that the market for all goods and services could be rendered perfect.

The issues pertaining to the concept of consumer's sovereignty or the values of economic democracy are distinctly different from the pure economic argument for the preservation of free choice in consumption! And it is in the interests of strict analysis to set aside these wider issues and to restrict one's attention to the pure economic argument.

## ii

The maximization of satisfaction remains the objective of every individual in any economic system. This objective can be most effectively realized by every consumer if there is a free market wherein he can acquire goods and services by spending his money income. The modern theory of value provides a conclusive proof of this proposition. An integrated statement of the essential parts of that theory would be extremely appropriate. But prior to such a statement, two important points need to be clearly mentioned.

First, the existence of a free market in consumption goods and services does not mean that there has been the fullest opportunity for the expression of the consumer's choice. In the question of *new* wants, the power of initiative always necessarily rests with the producer under the market system. The consumer has no means of indicating his preference in regard to the creation of new goods and services. This is an important deficiency of the market system. But this can be overcome by devising means of studying the individual's choice such as a sample survey of opinions of consumers through questionnaires or the collection of data from various consumers' organizations. But such devices, though they are extremely valuable in guiding production of new goods, could by no means be utilized to replace the market mechanism.<sup>1</sup> Once

<sup>1</sup> For a different viewpoint see Maurice Dobb, *Political Economy and Capitalism*, pp 306-15.



the goods are produced, the market-mechanism is both necessary and sufficient to decide the importance of the new good in the consumer's budget. The only important condition is that the market should be perfect. It can be safely assumed that a planned economy could achieve this since all elements of market imperfection could be eliminated and in addition the consumer can be furnished with the detailed knowledge of the entire production system.

Second, the only obstacle for unlimited exercise of choice on the part of each individual is his limited budget. But in addition to the money income, every individual might be provided with a number of goods and services free of any direct charge. So far as the individual is concerned these are free goods which can be utilized to the greatest advantage without any budgetary restriction. This category of free goods and services might well occupy a significant sector in a planned economy. In all enterprises wherein the variable costs are exceedingly small, almost tending to zero, there is a distinct economic advantage to the community in providing such goods and services free. Roads, railroads, bridges and canals are instances which have a virtually zero running cost. Electricity power plant, water works, gas and some heavy industries have, under modern methods of large-scale production, very small operating costs, though the cost of fixed equipment is enormous. In such cases, again, the individual may have the benefit of consumption without any direct charge. The entire cost of such enterprises is paid out of the Public Treasury directly. This follows from the general policy of pricing all goods at their marginal costs of production.

Further, it is a distinguishing feature of planning that a certain set of ends are given to or formulated by the Planning Authority the realization of which constitutes an important objective. Basic education, public health, entertainment and such other services might be provided on an extensive scale to the individuals without any charge. In all these cases, the

individual consumer has no *economic* problem at all, since he has an unlimited access to the use of all these services. His problem is only to direct his limited means such as his limited time and energy to derive the greatest satisfaction from these free goods. But while the consumer has no *economic* problem with regard to these goods and services, this is perhaps one of the most important *economic* problems for the Planning Authority. The resources of the community are limited relative to the needs and as such it is necessary that the supply of *free* goods and services to the consumer involves the most economical use of the community's resources. This problem is taken up at length in later chapters.

To the individual consumer the disposal of his limited money income in exchange for goods and services that provide him the largest satisfaction is the important *economic* problem. To the community as a whole, since all goods cannot be supplied free, the most appropriate distribution of the total output of consumption goods is the important *economic* problem. Both these problems can however be effectively solved by the functioning of price-mechanism. It is the concern of the following section to demonstrate this proposition.

### iii

It has been assumed at the very beginning of this study that money incomes of individuals are so regulated in a planned economy as to provide equal opportunity for all to exercise free choice of consumption. Each individual will strive to make his money go as far as possible in order to derive the largest possible amount of total satisfaction. With the existence of a free consumer's market and with a given set of prices of all the marketed goods and services, each individual will arrive at that combination of goods and services that afford him the largest utility. The equilibrium of the consumer results out of this fundamental opposition of 'tastes' and 'obstacles'.

Every consumer has a choice in respect of the whole range of consumption goods and services. In exercising his choice he has to act in accordance with his scale of preferences for the different goods. The individual arranges in an order all the possible combinations of goods in accordance with his tastes. In this unending series of an ascending order, there will be a number of series of indifferent combinations which give rise to absolutely equal satisfaction. With the knowledge of this scale of preferences each consumer can spend his given income on that combination which affords him the largest possible satisfaction.

In order to study this process, it is convenient to start with the case where only two goods, say,  $X$  and  $Y$  enter the consumer's budget. Let  $(x, y) = u$  be a continuous utility function where  $u$  is a positive parameter indicating the level of total utility of purchases  $x$  and  $y$  to the individual consumer. As the purchases of the individual vary the value of  $u$  will increase, remain constant or decrease according as the variation leaves the consumer better, indifferent or worse off.

Suppose the money income of the consumer is  $M$  and the prices of the goods  $X$  and  $Y$  are  $p_x$  and  $p_y$ . Then at these prices the individual can acquire  $x$  and  $y$  units of the goods such that :

$$x p_x + y p_y = M$$

This relation may be termed the *Budget Equation*.

The utility of the combination of goods  $X$  and  $Y$  is given by the utility function :

$$\phi(x, y) = u$$

which is assumed to possess continuous partial derivatives. The value of  $u$  is rendered maximum when  $du = 0$  and  $d^2u < 0$ . These conditions, translated into economic language, bear important meaning. The value of  $u$  must be rendered maximum relative to the budget equation :

$$x p_x + y p_y = M$$

which gives  $y$  as a function of  $x$

$$\text{i.e. } y = \frac{M - x p_x}{p_y}$$

$$\therefore \frac{dy}{dx} = - \frac{p_x}{p_y}$$

$$\text{and } \frac{d^2y}{dx^2} = 0$$

Turning to the utility function  $u = \phi(x, y)$

$$\frac{du}{dx} = \frac{\partial \phi}{\partial x} + \frac{\partial \phi}{\partial y} \frac{dy}{dx}$$

Denoting the partial derivatives by  $\phi_x$  and  $\phi_y$

$$\frac{du}{dx} = \phi_x + \phi_y \frac{dy}{dx}$$

which must reduce to zero

$$\frac{\phi_x}{\phi_y} = - \frac{dy}{dx} = \frac{p_x}{p_y}$$

Hence the necessary condition for a relative maximum value of  $u$  is  $\frac{\phi_x}{p_x} = \frac{\phi_y}{p_y}$

which demonstrates the proportionality of prices to marginal utilities.

Denoting  $\frac{\phi_x}{\phi_y}$  by  $R$

$$\text{then } R = \frac{p_x}{p_y}$$

$R$  is the marginal rate of substitution between the goods  $x$  and  $y$  and is equal to the ratio of their given market prices. This condition along with the budget equation enables the determination of the quantities  $x$  and  $y$  demanded at the market prices i.e. the demand functions of the consumer.

The sufficient condition for  $u$  to be maximum is

$$d^2u < 0$$

$$\text{Now } \frac{du}{dx} = \phi_x + \phi_y \frac{dy}{dx}$$

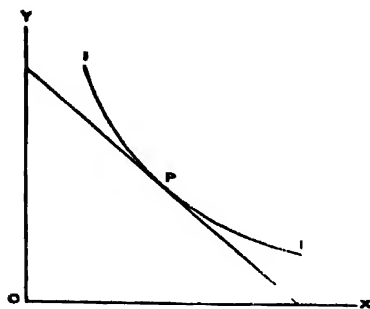
$$\begin{aligned} \therefore \frac{d^2u}{dx^2} &= \frac{\partial}{\partial x} \left( \phi_x + \phi_y \frac{dy}{dx} \right) + \frac{\partial}{\partial y} \left( \phi_x + \phi_y \frac{dy}{dx} \right) \frac{dy}{dx} \\ &= \left( \phi_{xx} + \phi_{xy} \frac{dy}{dx} + \phi_y \frac{d^2y}{dx^2} \right) + \left( \phi_{yx} + \phi_{yy} \frac{dy}{dx} \right) \frac{dy}{dx} \end{aligned}$$

$$\text{Since } \frac{dy}{dx} = - \frac{p_x}{p_y} \text{ and } \frac{d^2y}{dx^2} = 0$$

the sufficient condition becomes :

$$\phi_{xx} + \phi_{xy} \left( - \frac{p_x}{p_y} \right) + \phi_{yx} \left( - \frac{p_x}{p_y} \right) + \phi_{yy} \left( - \frac{p_x}{p_y} \right)^2 < 0$$

$$\text{i.e. } \frac{1}{p_y^2} \left[ \phi_{yy} p_x^2 - 2 \phi_{xy} p_x p_y + \phi_{xx} p_y^2 \right] < 0$$



In diagrammatic terms, the first condition expresses the tangency between the price-line and the indifference curve ; and the second condition, the convexity of the indifference curves with reference to the origin. In all normal cases where the principle of diminishing marginal rate of substitution is at work, there

is a unique combination of individual purchases for a given set of market prices and a given income that affords maximum satisfaction. This position is stable, and the consumer can arrive at this position by a free exercise of his choice.

In the above analysis the concept of the utility function is freely made use of. Since utility is essentially

a subjective phenomenon, the concept is a non-measurable one. But it is definitely capable of being ranked or ordered. Non-measurability does not invalidate the use of the utility function. In fact, the function  $u = \phi(x, y)$  is only one way of indicating the dependence of total utility on the quantities of  $X$  and  $Y$ . Any monotonic increasing function of  $u$ , say  $\log u$ , may be used. In general,  $U = F(u) = F\{\phi(x, y)\}$  may be termed the general index-function of utility.

Further, the concept of the ratios of marginal utilities which is of primary importance in the theory of choice is a definite one, independent of the immeasurability of utility. This can be easily demonstrated.

The general index-function of utility is

$$U = F(u) = F\{\phi(x, y)\}$$

Differentiating this function w. r. t.  $x$ .

$$\frac{\partial U}{\partial x} = F'(u) \frac{\partial u}{\partial x}$$

$$\text{Similarly } \frac{\partial U}{\partial y} = F'(u) \frac{\partial u}{\partial y}$$

$$\therefore \frac{\partial U}{\partial x} \cdot \frac{\partial U}{\partial y} = \frac{\partial u}{\partial x} \cdot \frac{\partial u}{\partial y}$$

The problem may now be generalized for an utility function depending on the consumption of  $n$  number of commodities  $X_1, X_2, X_3, \dots, X_n$ .

Denote the utility function by

$$u = \phi(x_1, x_2, x_3, \dots, x_n)$$

with continuous partial derivatives of the first two orders :

$$u_r = \frac{\partial u}{\partial x_r}, \quad u_{rr} = \frac{\partial^2 u}{\partial x_r \partial x_r} \quad (r=1, 2, 3 \dots n)$$

The consumer has a given income  $M$  which can be expended in the purchase of goods and services at the market prices  $p_1, p_2, p_3 \dots p_n$ .

Then the budget equation will be :

$$M = x_1 p_1 + x_2 p_2 + \dots + x_n p_n$$

Relative to this budget restriction the individual maximizes the total utility. The necessary condition for the maximum value of  $u$  is given by<sup>1</sup>

$$du = u_1 dx_1 + u_2 dx_2 + \dots + u_n dx_n$$

is zero subject to

$$p_1 dx_1 + p_2 dx_2 + \dots + p_n dx_n = 0$$

It follows that

$$\frac{u_1}{p_1} = \frac{u_2}{p_2} = \dots = \frac{u_n}{p_n} = \lambda$$

These ratios of marginal utilities to prices forming  $(n - 1)$  equations along with the budget equation determine the equilibrium quantities the consumer acquires at the market prices.

In order that the above utility function  $u$  attains the maximum value at  $du = 0$ ,  $d^2u$  must be negative and of a definite quadratic form for all increments  $dx_1, dx_2, dx_3, \dots, dx_n$  subject to the budget restriction

$$x_1 p_1 + x_2 p_2 + \dots + x_n p_n = M$$

Now  $du = u_1 dx_1 + u_2 dx_2 + \dots + u_n dx_n$

$$\therefore d^2u = u_{11} dx_1^2 + u_{12} dx_1 dx_2 + u_{22} dx_2^2 + \dots + 2 u_{12} dx_1 dx_2 + \dots$$

Since the budget equation is a linear function the second differential  $d^2x_1 = 0$ .

$\therefore$  eliminating  $d^2x_1$

$$d^2u = u_{11} dx_1^2 + u_{22} dx_2^2 + \dots + 2 u_{12} dx_1 dx_2 + \dots$$

This expression can be arranged in the form

$$\begin{aligned} d^2u &= u_{11} dx_1^2 + u_{12} dx_1 dx_2 + \dots + u_{1n} dx_1 dx_n \\ &+ u_{21} dx_2 dx_1 + u_{22} dx_2^2 + \dots + u_{2n} dx_2 dx_n \\ &+ \dots \\ &+ u_{n1} dx_n dx_1 + u_{n2} dx_n dx_2 + \dots + u_{nn} dx_n^2 \end{aligned}$$

<sup>1</sup> Allen, op cit, pp 498-500.

This expression<sup>1</sup> will be a negative quadratic subject to

$$p_1 dx_1 + p_2 dx_2 + \dots + p_n dx_n = 0$$

$$\text{i.e. } u_1 dx_1 + u_2 dx_2 + \dots + u_n dx_n = 0$$

$$\text{if } \begin{vmatrix} 0 & u_1 & u_2 & \dots & u_n \\ u_1 & u_{11} & u_{12} & \dots & u_{1n} \\ u_2 & u_{21} & u_{22} & \dots & u_{2n} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ u_n & u_{n1} & u_{n2} & \dots & u_{nn} \end{vmatrix} > 0, \quad \begin{vmatrix} 0 & u_1 & u_2 & \dots & u_n \\ u_1 & u_{11} & u_{12} & \dots & u_{1n} \\ u_2 & u_{21} & u_{22} & \dots & u_{2n} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ u_n & u_{n1} & u_{n2} & \dots & u_{nn} \end{vmatrix} < 0, \dots$$

i.e. alternately positive and negative.

These expressions provide the stability conditions of equilibrium. They reveal the nature of the utility function and indicate the principle of diminishing marginal rate of substitution applied to  $n$  commodities. The principle holds true for all normal cases. If there are only two goods the conditions imply a downward sloping indifference curve convex to the origin. When there are three goods, they imply that the indifference surfaces of the consumer are downward sloping and convex to the origin at all points.

The equilibrium conditions and the stability conditions are developed here on the assumption of the existence of a particular utility function. But these conditions do not depend on any unique utility function. For, suppose the utility function  $u$  is replaced by some other arbitrary function of  $u$ ,  $F(u)$ . Then it can be proved that the equilibrium conditions and stability conditions remain unaffected provided  $F(u)$  increase as  $u$  increases i.e.  $F'(u)$  is positive, which is a legitimate assumption.

$$\text{Now } \frac{\partial}{\partial x_r} F(u) = F'(u) u_r$$

Therefore the equilibrium conditions remain unchanged except for a common multiple  $F'(u)$

$$\frac{u_1 F'(u)}{p_1} = \frac{u_2 F'(u)}{p_2} = \dots = \frac{u_n F'(u)}{p_n}$$

<sup>1</sup> Allen, op. cit., pp. 491-2.



which can as well be written :

$$\frac{u_1}{p_1} = \frac{u_2}{p_2} = \dots = \frac{u_n}{p_n} = k \text{ a constant.}$$

Regarding the stability conditions

$$\frac{\partial^2 u}{\partial x_r \partial x_s} F(u) = \frac{\partial}{\partial x_s} [F'(u) u_r] = F'(u) u_{rs} + F''(u) u_r u_s$$

Therefore the first inequality determinant will be of the form :

$$\begin{vmatrix} 0 & F'(u) u_1 & F'(u) u_2 \\ F'(u) u_1 & F'(u) u_{11} + F''(u) u_1^2 & F'(u) u_{12} + F''(u) u_1 u_2 \\ F'(u) u_2 & F'(u) u_{12} + F''(u) u_1 u_2 & F'(u) u_{22} + F''(u) u_2^2 \end{vmatrix}$$

which will reduce to

$$[F'(u)]^3 \begin{vmatrix} 0 & u_1 & u_2 \\ u_1 & u_{11} & u_{12} \\ u_2 & u_{21} & u_{22} \end{vmatrix}$$

The same reduction can be performed for every other determinant of the series. The  $r$ th determinant will have a multiple  $[F'(u)]^{r+2}$ . Thus the original conditions obey the property of being invariant against the substitution of an arbitrary function of  $u$ .

The propositions stated in this form have the distinct advantage of bringing into one sweep all the intricate interrelations of demand for consumption goods.<sup>1</sup> Proceeding on this basis, an extensive analysis of the market demand for consumption goods and the effects of price or income changes on the complementary and substitute goods has been systematically developed by Hicks. These theorems have an enormous

<sup>1</sup> Allen has worked out a general theory of choice resting on the firmer foundation of the principle of diminishing marginal rate of substitution. In his theory, the 'integrability' case reduces to a special case of a general theory which includes even cases of non-integrability. Though logically this is more perfect and rigorous, the properties of complementarity and substitution among interrelated goods cannot be expressed in this theory in a readily understandable form.

significance in econometric studies in planned systems.

## iv

It is clear that every consumer can expend his income to the maximum advantage given a set of market prices. This follows from the principle of the diminishing marginal rate of substitution, which rests on more secure grounds than the principle of diminishing marginal utility.<sup>1</sup> In a system of free enterprise 'prices' are regarded as objective constants both to the buyer and the seller. But this 'parametric' function of prices could exist only under conditions of atomistic perfect competition. In a planned economy this 'parametric' function of prices is administered by the Planning Authority. Prices for all goods and services are fixed by the Planning Authority which are essentially arbitrary, though it could be based on the knowledge available regarding the market demand behaviour and the production capacities of all the firms. But this arbitrary character of the initial pricing does not in any way obstruct the adjustment of the forces of supply and demand at the equilibrium price. Regarding the demand for goods it has been demonstrated that each individual will select that combination of goods which places him in the most preferred position. This process of choice results in a concrete aggregate demand by the community for each commodity at the given price. The supply of goods flows from the firms which are instructed to regulate output in such a manner that the marginal costs of production are equal to the prices fixed by the Planning Authority. Thus both the aggregate demand for and aggregate supply of every commodity have a distinct functional relationship with its price. Equilibrium of exchange is attained only when there is complete equality of demand and supply for every commodity. If the aggregate demand exceeds aggregate supply, there is a clear case for price revision in the upward direction and vice versa. Through

<sup>1</sup> Hicks, *op cit.*, pp 22-3.

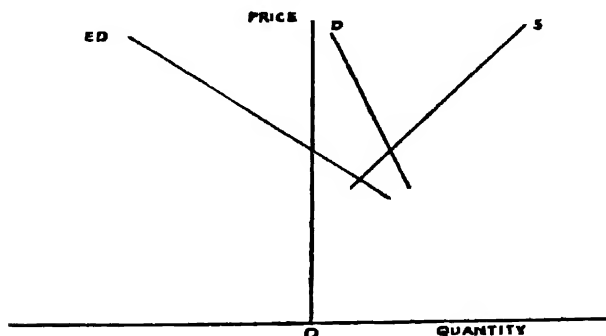
successive price revisions by the Planning Authority there could always be maintained the closest approximation if not absolute equality with the equilibrium prices.

It could be seen that the quantity adjustments for price changes under the conditions assumed in a planned economy follow a convergent path toward equilibrium. The reasons are obvious. First there does not exist an income inequality of an order which distorts the general preference scales of the community lending an undue weightage to the preferences of any one individual or section of society. Second, demand and supply have a relevance only to the period in which money incomes of the individuals have to be spent away. The possibility of withholding current expenditure thereby storing up money for future consumption is ruled out. It is the *absence* of these two conditions in the existing individualist systems that are partly responsible for the violent price fluctuations and the Wicksellian cumulative process of disequilibrium.

The concept of aggregate supply of a commodity is definite in a planned economy. Innumerable difficulties are encountered in the individualist systems in giving a meaning to the concept of supply curve owing to the presence of market imperfection or product differentiation or oligopoly. These difficulties disappear with the central regulation of the production system by means of a general rule enforcing the equalization of prices and marginal costs. The market for goods and services is rendered perfect. The climate in which product differentiation or oligopoly thrives is totally absent. Therefore the determination of exchange-equilibrium in consumption goods reduces to great simplicity in a planned economy. Movements away from equilibrium positions could arise only as a result of *natural* changes due to changes in tastes and population or in resources and their method of application.

The problem of the stability of equilibrium can now be examined. It has been shown that the equilibrium of the consumer implies the equality of price-ratios and the marginal rates of substitution among the goods the individual consumes. From this property it can be deduced that any price reduction of one good leads to income and substitution effects in its favour for all 'normal' goods.<sup>1</sup> And it is the case of 'normal' goods that is of interest in this analysis since both the cases of 'inferior goods' and the Veblenesque case of goods of ostensible display are of importance only in a system where wide inequalities of income prevail. For all 'normal' goods the individual demand curves are downward sloping. It automatically follows that in a community wherein there is equal opportunity of choice for all individuals, the market demand curve is also downward sloping.

Stability of exchange at the equilibrium position is assured when a price fall of the commodity leads to an excess of demand over supply.<sup>2</sup> That is, the excess demand curve must be downward sloping.



This condition is easily satisfied when the supply curve is rising to the right, since the demand curve is

<sup>1</sup> Hicks, *op. cit.*, pp. 26-28.

<sup>2</sup> Hicks, *op. cit.*, p. 63. He states the condition with reference to exchange of two goods.

*necessarily* falling to the right. This means that under conditions of rising marginal costs of production, stability of equilibrium is effectively attained since successive price falls from the equilibrium position create an increasing excess demand. But rising marginal costs are a common feature only under perfect competition. With the growth of large-scale production, industries producing under conditions of falling marginal costs have acquired a greater dominance. The stability rule in this case fails since beyond the equilibrium position price must necessarily fall at a greater rate than the cost ; and under such conditions, a price fall will set the excess demand in the reverse direction. This is obvious since the Hicksian stability propositions are applicable only under conditions of perfect competition. But under conditions of falling marginal costs, such an instability indicates the potential benefit by expanding production. Since prices should always be equal to marginal costs,<sup>1</sup> and falling marginal costs imply that resources are more economically applied with the successive increments of output, it is to the *economic* advantage of the community to pursue this expansionist path till the marginal costs almost tend to zero when such a good can be declared a free good or when the marginal costs tend to be constant or begin to rise so that stability conditions are satisfied automatically. The expansionist path pursued by such enterprises by no means implies misdirection of resources since all the variable factors of production have a free market so that factors can always move out to enterprises wherein they earn a higher reward. Prolonged fall in marginal cost only points out the enormous degree of internal economy available in the enterprise which can off-set the scarcity of variable factors.

In the matter of free goods or goods that have been priced very low (on the principle of marginal-cost-price equality) the aggregate demand might far exceed the aggregate supply. Standard instances of

<sup>1</sup> The necessity for this is discussed in Chapter III.

this situation are passenger transport and theatres for entertainment. In the absence of a higher fare, to queue up would be the only alternative. But a convenient way of regulating demand in accordance with the supply available is by fixing a rental charge at the level which just reduces the size of the demand to exhaust the supply.<sup>1</sup> This rental charge constitutes a surplus which can be treated as quasi-rent. Obviously, this calls for an increase in the long run in the number and/or size of such enterprises. In case the scarcity persists in the long run too the rental charging is a sound *economic* method of adjusting demand to supply even in the long run. But goods and services provided in this manner are no longer *free* from the viewpoint of the consumer. They are subject to the same budget restriction as other scarce goods, and the theory of choice determines the consumption of such goods.

<sup>1</sup> Hotelling, *op cit*, p. 257.

## ALLOCATION OF RESOURCES

AN appropriate allocation of productive resources is the most *crucial* problem of a centrally planned economy. A major part of the criticism against collectivist planning has been directed towards pointing out the essentially arbitrary or 'irrational' character of production- that it involves enormous wastage and misdirection of the precious resources of the community. It is argued that mistakes often occur in decisions regarding production and that they tend to be cumulative as opposed to the cancelling out of mistakes under atomistic competition by the law of large numbers. Further, there is no ready means with which mistakes would be corrected in the absence of private responsibility for success or failure in the production process. This absence might well lead to the relegation of economic considerations to the background and the dominance of technological adventure in productive activity. Stated in this way it is difficult to get away from the intrinsic complexity of the problem of planning. One way has been pointed out by Maurice Dobb. Granting the existence of a consumer's market so long as there is absence of plenty, he suggests that the organization of production would be most efficiently undertaken by means of a proper estimate of the relative productivities of different factors.<sup>1</sup> Factors could be shifted from occupations of lower productivity to those of higher productivity till the balance is reached at which each factor is contributing its best at the margin. This solution though theoretically sound and seemingly simple would in practice lead to enormous difficulties of computation. In its lack

<sup>1</sup> Maurice Dobb, *Political Economy and Capitalism*, pp 300-6

of ready applicability it would not be very different from its diametrically opposite extreme, namely, the determination of equilibrium outputs and prices by means of the Walrasian simultaneous equations.

## i

The problem could however be successfully attacked both in theory and in practice, if once again the fundamental importance of the price-mechanism is admitted. Before developing this argument, an important reservation however needs mention.

Economic analysis fails in extending its applications to an important set of problems relating to the activities of the state. Matters such as administration and defence do not readily lend themselves to *economic* tests because of their being incalculable *economic* units. All such affairs involve a highly arbitrary element; and it is difficult to provide a measure of the degree of arbitrariness. But this is a 'deficiency of economic theory as such, and as a whole'.<sup>1</sup> Therefore, leaving aside this sector, it could be demonstrated that the acceptance of the theory of consumer's choice leads to a ready solution of the difficult problem of production under planning.

In the manner in which choice of consumption could lead to the optimum distribution of the total output of consumption goods, in an identical manner free choice of occupation would bring about the most appropriate distribution of resources in the productive activity of the community. The existence of a free market for labour and other resources including money capital would enable the flow of resources into those channels wherein the highest reward is obtained. Here it is legitimate to assume that the market for factors of production could be rendered perfect in a planned economy in the absence of forces creating market imperfection and monopsony. Under such conditions, the task of estimating and comparing the productivities of different factors is rendered

<sup>1</sup> Hicks, *op cit*, pp. 99-100.



entirely superfluous by a successful application of the marginal principle. Each factor could be employed up to that point at which its marginal product equals the cost of employing it, i.e. the price of the factor. So long as the marginal product exceeds the price of the factor, it is to the gain of the producer to increase its input. The equilibrium input of each factor in the firm is determined by the equality of marginal product and the price of the factor. Here again the parametric function of prices is obvious. Under perfect competition the free play of the forces of supply and demand determine the equilibrium price of the factor. In a planned economy, the same competitive process is at work ; but the prices are fixed by the Planning Authority. Price revisions would follow the same course as in the case of consumption goods, always tending to the equilibrium price of the factor at which the aggregate supply is just exhausted by the aggregate demand. The forces causing price-fluctuations and disequilibrium in the factor market can be safely assumed to be totally absent in a planned economy.

The theory of choice effectively reveals the perfect symmetry between choice of consumption and choice of production. Just as the principle of diminishing marginal rate of substitution enables the consumer to attain the most preferred position by arriving at that combination of goods at which their price-ratios are equal to the ratios of marginal utilities, that is, their *marginal rate of substitution*, in an identical manner the principle of diminishing marginal productivity enables the producer to attain the most preferred position by arriving at that combination of factors at which their price-ratios are equal to the ratios of their marginal products, that is, their *marginal rate of transformation*. This idea is developed at length in the analysis of the firm.

In a planned economy the problem of the allocation of freely variable resources lends itself to great simplicity. It just insists on the obedience to the

rule that each production unit must employ that quantity of the factor at which the marginal product (i.e. the value of the marginal physical product multiplied by the price of the product) equals the price of the factor.<sup>1</sup> The fundamental importance of this rule is most effectively brought out by A. P. Lerner in his *Economics of Control*.

This highly simplified picture of the production process is helpful in bringing into relief the nature of the long-run problem of the allocation of resources. In the long run all the factors are divisible and thereby freely variable. The position of maximum advantage to the community in the long run is attained when its resources are most economically employed. That is the same thing as stating that production is carried on under conditions of minimum total cost. This condition is satisfied only when the price of the product is equal to the marginal cost of production and the price of the factor equals the value of the marginal product.

This can be demonstrated algebraically in a simple manner. Since all resources are perfectly divisible in the long run the production function is linear and homogeneous obeying the condition of constant cost. Suppose the production of good  $X$  is subject to the production function

$$x = \phi (a_1, a_2, a_3 \dots a_n)$$

and the prices of the factors  $a_1, a_2, a_3 \dots a_n$  are  $p_1, p_2, p_3 \dots p_n$ .

The first problem is to find the combination of factors that leads to minimum total cost. That is,

$$\bar{\pi} = a_1 p_1 + a_2 p_2 + \dots + a_n p_n$$

has got to be minimized relative to

$$x = \phi (a_1, a_2, a_3 \dots a_n)$$

<sup>1</sup> The reward for the factor labour on the basis of marginal product is different from the money earnings of the individuals. The difference is made up by the provision of real benefits such as increased leisure and additional amenities. There is however an arbitrary element involved in such a calculation. See Oscar Lange, "On Economic Theory of Socialism", *R. E. S.*, Vol. IV, p. 64.

The necessary condition<sup>1</sup> is

$$d\bar{\pi} = p_1 da_1 + p_2 da_2 + \dots + p_n da_n$$

is zero subject to

$$dx = \phi_1 da_1 + \phi_2 da_2 + \dots + \phi_n da_n = 0$$

It follows

$$\frac{p_1}{\phi_1} = \frac{p_2}{\phi_2} = \dots = \frac{p_n}{\phi_n} = \lambda$$

Further,  $\bar{\pi}$  is the total cost of production of output  $x$ . Therefore the average cost of output is

$$\begin{aligned} \frac{\bar{\pi}}{x} &= \frac{a_1 p_1 + a_2 p_2 + \dots + a_n p_n}{x} \\ &= \lambda \frac{(a_1 \phi_1 + a_2 \phi_2 + \dots + a_n \phi_n)}{x} \end{aligned}$$

$$\text{But } a_1 \phi_1 + a_2 \phi_2 + \dots + a_n \phi_n = x$$

by Euler's Theorem.

$$\text{Therefore } \frac{\bar{\pi}}{x} = \frac{\lambda x}{x} = \lambda$$

Now, if the output varies while the prices of factors remain constant, the marginal cost at the output  $x$

$$\begin{aligned} &= \frac{d\bar{\pi}}{dx} = p_1 \frac{da_1}{dx} + p_2 \frac{da_2}{dx} + \dots + p_n \frac{da_n}{dx} \\ &= \lambda \left( \phi_1 \frac{da_1}{dx} + \phi_2 \frac{da_2}{dx} + \dots + \phi_n \frac{da_n}{dx} \right) \\ &= \lambda, \end{aligned}$$

since  $dx = \phi_1 da_1 + \phi_2 da_2 + \dots + \phi_n da_n$  by the production function.

Therefore  $\frac{\bar{\pi}}{x} = \frac{d\bar{\pi}}{dx} = \lambda$  which means average cost and marginal cost are equal and constant for all outputs.

<sup>1</sup> Allen, op. cit., pp 498-500.

In the long run, the price is equal to the cost of production.

$$\therefore \text{price of } X, p = \frac{\bar{\Pi}}{x} = \lambda$$

$\therefore$  the common equilibrium ratios will be :

$$\frac{p_1}{\phi_1} = \frac{p_2}{\phi_2} = \dots = \frac{p_n}{\phi_n} = p$$

$$\text{i.e. } p_r = p \phi_r \quad (r = 1, 2, 3 \dots n).$$

This is the law of marginal productivity, demonstrating that minimum total cost corresponds to the equality of the price of the factor and the value of the marginal product.

Now the side relation gives  $a_1$  as a function of  $a$ ,  $a_2$ , . . .  $a_n$ . Differentiating twice, we obtain the expression

$$\phi_1 d^2 a_1 + \phi_{11} da_1^2 + \phi_{22} da_2^2 + \dots + 2 \phi_{12} da_1 da_2 + \dots = 0$$

For  $\Pi$  to acquire minimum value,  $d\Pi = 0$  and  $d^2 \Pi > 0$ .

$$d\bar{\Pi} = p_1 da_1 + p_2 da_2 + \dots + p_n da_n$$

$$\therefore d^2 \bar{\Pi} = d(p_1 da_1 + p_2 da_2 + \dots + p_n da_n)$$

$$= p_1 d^2 a_1, \text{ which from the above}$$

relation

$$= - \frac{p_1}{\phi_1} [\phi_{11} da_1^2 + \phi_{22} da_2^2 + \dots + 2 \phi_{12} da_1 da_2 + \dots]$$

$$\text{i. e. } - \frac{p_1}{\phi_1} \left[ \phi_{11} da_1^2 + \phi_{12} da_1 da_2 + \dots + \phi_{12} da_1 da_2 + \phi_{22} da_2^2 + \dots + \dots + \phi_{1n} da_1 da_n + \phi_{2n} da_2 da_n + \dots + \phi_{nn} da_n^2 \right]$$

The expression in brackets is a negative quadratic form subject to the condition,

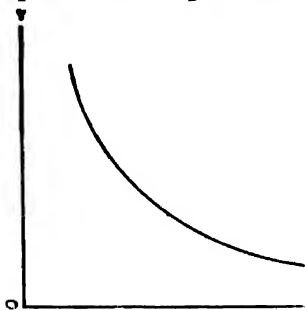
$$\phi_1 da_1 + \phi_2 da_2 + \dots + \phi_n da_n = 0$$

Therefore the sufficient condition can be stated<sup>1</sup>

$$\begin{vmatrix} 0 & \phi_1 & \phi_2 \\ \phi_1 & \phi_{11} & \phi_{12} \\ \phi_2 & \phi_{21} & \phi_{22} \end{vmatrix} > 0, \quad \begin{vmatrix} 0 & \phi_1 & \phi_2 & \phi_3 \\ \phi_1 & \phi_{11} & \phi_{12} & \phi_{13} \\ \phi_2 & \phi_{21} & \phi_{22} & \phi_{23} \\ \phi_3 & \phi_{31} & \phi_{32} & \phi_{33} \end{vmatrix} < 0 \dots$$

i.e. alternately positive and negative.

Assuming that the marginal products  $\phi_1, \phi_2, \dots, \phi_n$  are all positive and the above minimization inequalities are satisfied, then for *any* set of outputs and prices of the factors over a given range, equilibrium is possible and the position is stable. The



stability conditions indicate the limitation imposed on the production function, namely, the diminishing marginal productivity of each factor. When there are only two factors this implies that the constant product curve is convex to the origin.

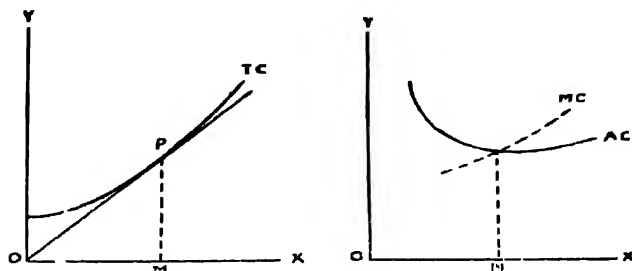
The equilibrium position is thus stable at all points where the constant product curve is convex to the origin.

In the case of three variable factors the stability conditions imply that the constant product surfaces in factor space are downward sloping and convex to the origin at all points over a given range. Given these conditions, the demand functions for factors are stable and uniquely determinate.

This analysis reveals the inherent soundness of the rule of equalizing price of the factor with the value of marginal product in all cases where the supply of factors is freely variable.

<sup>1</sup> Allen, *op. cit.*, pp. 491-2.

But it is only under conditions of perfect competition and when production is subject to constant costs i.e. the production function is linear homogeneous that the conditions of equality between the price of the variable factor and its marginal product also entails the equality of the price of the product and its marginal cost of production. This reciprocal relationship between input and output loses much of its elegance owing to the utilization of lumpy or indivisible units



in the production process. The existence of fixed factors enables the expansion of output till a certain point at a diminishing rate of increase in the total cost of production. Within that range average cost of production will be falling and marginal cost will be below average cost. Further, even though marginal cost begins to rise, average cost continues to fall till the point of minimum average cost is reached.

#### 11

It is the characteristic feature of modern enterprises that a major part of production is subject to falling average costs. With modern advancements in large scale methods of production, a significant section of enterprises may even be subject to production under conditions of falling marginal costs. In both the cases, however, equilibrium is determinate and stable so long as the marginal cost of production equals the marginal revenue—the conditions which define the existence of monopoly or monopolistic competition. The price of the product is necessarily above the

marginal cost of production (and in cases of monopoly, even above the average cost) the price exceeding it by a percentage dependent on the elasticity of demand for the commodity.

A policy of pricing at marginal cost of production is out of the question so long as these enterprises are undertaken by private individuals or private corporations. For, such a course would lead to the total receipts by the sale of output to fall short of the total cost of production which must take into account the cost of fixed equipment. This latter cost is a *real* cost to the producer and has got to be recovered during the lifetime of the equipment, if he wants to escape loss. Equilibrium position under such conditions involves the existence of unused capacity which could be eliminated only when the average costs stop falling.

Production under falling costs has far-reaching *economic* implications. The mere fact that the expansion of output leads to lowering of costs is a convincing argument for production to be extended. Further, the indirect effects of expansion are even more significant. The existence of internal economies in one industry does mean the availability of external economies to all the industries which are dependent on the former for their supply of resources. The effect may be spread over a group of industries, a particular region or over all industries.<sup>1</sup> The wide sources from which 'increasing returns' springs and the far and wide effects it has on the economic system has been shown in the clearest manner by Allyn A. Young.<sup>2</sup> The policy of maximizing general welfare implies the utilization of internal economies in each enterprise to the maximum possible degree.

### iii

Pricing a commodity above its marginal cost of production leads to a distinct loss of welfare to the consumer without a corresponding gain to the community.

<sup>1</sup> Joan Robinson, *Economics of Imperfect Competition*, Appendix.

<sup>2</sup> "Increasing Returns and Economic Progress", *E. J.*, Vol. XXXVIII, pp. 527-40.

So long as the cost of producing the additional unit of a commodity is smaller than the price charged to the consumer, the consumer is making a sacrifice of an amount which is greater than what it has cost the community to supply him the means of satisfaction in exchange. This follows from the fact that the cost to the community of supplying the individual that particular unit is measured by the loss resulting from the diversion of the required amount of variable factors from their alternative sources of employment. And this is just what is meant by the marginal cost of production.

The justification for pricing above the marginal cost of production is often advanced on the ground of realizing the cost of fixed equipment through the sale of output. But in an economy aiming at the maximization of *general welfare* such a justification loses its meaning in entirety. The principle that 'every tub must stand on its own bottom' has its significance only when the responsibility for individual enterprises rests in private hands. Once the equipment has been installed, its use tends to be specific. The factor ceases to have a cost in the sense of the alternative uses to which it can be put into. Expenses have been already incurred; and the extent to which the fixed equipment is put into use depends on the extent to which variable factors of production are drawn from their alternative means of employment. The amount of fixed equipment is constant whether the output produced is zero, small or large. With regard to the production of output, 'the only costs that are relevant are costs the incurrence of which is in question. They are therefore all prime. Supplementary costs are for us nothing but a useless carry over from capitalist book-keeping practices.'<sup>1</sup>

iv

This conclusion has indeed a revolutionary significance. Lerner has the distinction of 'having fought

<sup>1</sup> A.P. Lerner, 'Statics and Dynamics in Socialist Economics', *E. J.*, Vol. XLVII, p. 264



for' the application of this principle to the problems of a socialist economy. Acceptance of this principle would mean the displacement of the orthodox canon of economic theory that each enterprise must be self-financing by a radically different set of considerations. And the reorientation of approach to the economic problem from the end of planning as opposed to the end of atomistic competition would find the application of this principle of extreme advantage. Moreover the application of such a principle in all its logical thoroughness is possible only when the entire economic map of the community is viewed as an integrated whole; and the 'profit and loss' considerations of individual business units give way to the overriding considerations of the most *economical* use of the community's resources.

A programme of production based on this principle would lead to spectacular results. Enterprises which would obviously be in the interest of general welfare and yet never undertaken because of the impossibility of realizing the entire cost by means of the sales receipts could be undertaken on this principle and supplied at a price which is negligibly small or even zero. The integrated policy of the Planning Authority would facilitate the ready introduction of inventions and innovations that economize the use of variable resources to a degree more than proportionate to the cost of applying new inventions. This is possible only under centralized planning since it involves the scrapping of dead investment and letting bygones be bygones.

The stimulating effect of 'increasing returns' on the economic life of the community would be much more immense than under free enterprise where technical economies are resisted owing to institutional considerations of private capital. Besides, the very criterion with which the initiation of new enterprises is undertaken is extremely conservative in the individualist systems since it is based on the expectation of recovering the entire cost by charging a price which will at least equal the average cost of production.

Pricing at marginal cost would naturally mean the utilization of economies of production to the maximum advantage.<sup>1</sup> But, as pointed out by Allyn Young, the phenomenon of increasing returns is such that it has its influence spread over the entire economic system; and the various activities that constitute economic progress generate this phenomenon. That is the reason why to assess the amount of 'internal economies' and 'external economies' of any one firm or group of firms is a particularly impossible task introducing insoluble difficulties in building up the concept of a supply curve of an industry. But once again the reorientation of approach in this study makes it possible to bring into light the *total* benefits to the community of the phenomenon of increasing returns which is all that is necessary. The nature of the allocation of external economies over any one portion of the economy is not germane to planning; it is their aggregate amount that matters which is always positive so long as average costs are falling and pricing of goods are at their marginal costs of production.

#### V

But the complete acceptance of this principle would be possible only when it is proved that the general welfare of the community is maximized provided all costs of fixed equipment are directly paid out of the public treasury and any means of fixing prices above their marginal costs, with a view to cover the costs of fixed equipment, would lead to a definite diminution in the consumer's welfare. That is, the consumer would benefit to a greater extent by expending a smaller money income in acquiring goods of consumption priced at their marginal costs than by expending a larger money income in acquiring goods at prices higher than marginal costs, the difference constituting the charge to realize the cost of fixed equipment. For the cost of fixed equipment must be met with anyway by the community. That method

<sup>1</sup> R.F. Kahn, "Some Notes on Ideal Output", *E J*, Vol. XLV, pp. 1-19

which entails least sacrifice on the part of the individuals commends itself best. An impeccable proof of this proposition and its revolutionary implications are advanced by Professor Harold Hotelling.<sup>1</sup>

The theory of consumer's choice has shown that each individual strives to attain the most preferred position given the market prices, subject to the restriction of his budget.

The consumer's utility function is given by

$$u = \phi(x_1, x_2, x_3, \dots, x_n)$$

$u$  may be replaced by any other arbitrary function  $F(u)$  of  $u$ .

The budget restriction is given by

$$M = x_1 p_1 + x_2 p_2 + \dots + x_n p_n$$

$$\text{i.e. } M = \sum_{r=1}^n x_r p_r \quad (1)$$

Assume that all goods of consumption are priced at their marginal costs of production

The value of  $u$  is rendered maximum subject to the budget restriction. Therefore, if  $x_1, x_2, x_3, \dots$  are the quantities chosen under this condition and  $x'_1, x'_2, x'_3, \dots$  are any other set of quantities satisfying the budget equation, then

$$x'_1 p_1 + x'_2 p_2 + \dots + x'_n p_n = M \quad (2)$$

But since  $u$  is rendered maximum, it follows

$$\frac{u(x_1, x_2, \dots, x_n)}{\phi(x'_1, x'_2, \dots, x'_n)} > u + \delta u$$

Putting  $x'_r = x_r + \delta x_r$  and subtracting (2) from (1), we have  $\sum p_r \delta x_r = 0$  (3)

For any values of  $\delta x_1, \delta x_2, \dots, \delta x_n$  satisfying the above condition, and not all of them being zero, the following property must hold true.

$$\begin{aligned} \delta u &= \phi(x_1 + \delta x_1, x_2 + \delta x_2, \dots, x_n + \delta x_n) \\ &\quad - \phi(x_1, x_2, \dots, x_n) < 0 \quad (4) \end{aligned}$$

Consider now a change in prices, prices being fixed above the marginal costs, followed by a corresponding

<sup>1</sup> Hotelling, *op cit*, pp 248-56

enlargement in the consumer's money incomes such that the entire cost of fixed equipment is recovered through the yield of the surplus of prices over marginal costs. The prices, income, and quantities of goods consumed in the new position are denoted by

$$p_r' = p_r + \delta p_r, M' = M + \delta M, \text{ and } x_r' = x_r + \delta x_r, \quad (5)$$

$\delta p_r$  and  $\delta x_r$  may acquire any signs.

The total yield of the surplus due to the rise in price above the marginal cost will be the sum, over all individuals, of the quantity which for the individual consumer under consideration is given by

$$\sum x_r' \delta p_r$$

Since the money income of the individual has increased from  $M$  to  $M + \delta M$ , the net increment of revenue to the Government imputed to this individual consumer is

$$\delta R = \sum x_r' \delta p_r - \delta M \quad (6)$$

The summation of  $\delta R$  over all individuals gives the total increment of government revenue. This, according to our assumptions, must be zero since the increase in the money incomes of the individuals is just by the amount of the cost of the fixed equipment.

The individual's budgetary restriction is now represented by

$$\sum (p_r + \delta p_r) (x_r + \delta x_r) = M + \delta M \quad (7)$$

Subtracting (7) from (1)

$$\begin{aligned} \delta M &= \sum (p_r + \delta p_r) (x_r + \delta x_r) - \sum p_r x_r \\ &= \sum (x_r + \delta x_r) \delta p_r + \sum p_r \delta x_r \\ &= \sum x_r' \delta p_r + \sum p_r \delta x_r \quad \text{from (5)} \end{aligned}$$

Substituting this in (6),

$$\begin{aligned} \delta R &= \sum x_r' \delta p_r - (\sum x_r' \delta p_r + \sum p_r \delta x_r) \\ &= - \sum p_r \delta x_r \end{aligned}$$

Since  $\delta R = 0$ ,  $\sum p_r \delta x_r = 0$

and therefore the condition (3) is satisfied.

Hence, except in the highly unlikely situation where all the  $\delta x_r'$  are exactly zero, the condition

(4) follows, which means that the individual is worse off in the new state. The change from the policy of direct charge on the treasury and pricing at marginal cost to the policy of pricing higher than marginal cost has led to the loss in the satisfaction of the individual without any difference whatsoever to the Government. Pricing at marginal cost is the only position in conformity with maximum general welfare.

# vi

In putting forward this proof the initial position of price at marginal cost is implicitly assumed to be the position that is in the interests of maximum general welfare. Such an assumption may however be challenged. It may be argued that the proof only shows that change from any basic price position would lead to diminution of welfare and as such 'changes in general go bad to worse';<sup>1</sup> that there is nothing intrinsic in the proof to suggest that initial prices should be at marginal costs. A refutation of this criticism is again quite simple.<sup>2</sup>

Suppose for instance a railway service is charging a fare  $p$  higher than the marginal constant cost  $c$ .  $x$  tickets are sold at that fare. The ordinary revenue to the government (above the marginal cost) is  $(p - c)x$ . Now, if an additional levy is made on the traffic by way of a rise in the fare from  $p$  to  $p'$  in order to cover the fixed cost of the railway equipment, then the additional revenue that flows to the government is  $(p' - p)x'$ , when  $x'$  is the number of tickets sold at the higher price  $p'$  and therefore in all probability less than  $x$ .

Since the purpose of additional levy is just to cover the cost of fixed equipment, it follows that there has been a corresponding enlargement of money income of the consumers such that the price rise has in no way altered their amount of satisfaction. That is, by imputing the increment in revenue to the individual consumer,

$$x'(p' - p) - \delta M = 0$$

<sup>1</sup> Frisch Ragnar, "A Further Note on Dupuit Taxation Theorem", *Econ.*, Vol. VII, 156-7.

<sup>2</sup> Hotelling, "A Final Note", *Econ.*, Vol VII, pp. 158-60.

While this is satisfactory so far as the financing of the fixed equipment goes, it is clearly not in the interest of the government since it is losing ordinary revenue because only  $x'$  tickets are sold at  $p'$ . In order that the ordinary revenue should remain unchanged

$$x(p - c) = x'(p' - c)$$

As it is unlikely that  $x' = x$ , i.e. the rise in price has no effect on the sale of tickets, the only other condition must be  $p - c = 0$ ,  $p = c$ . This is the way that pricing at marginal cost forms the *essential* condition.

The proof of this proposition is of first-rate importance since the entire application of the marginal principle centres round devising the most economical way of meeting the cost of fixed equipment. Lerner stresses the input approach of pricing the factor at its marginal product as the fundamental principle and thereby pleads for the substitution of this principle for the 'earlier one' of pricing output at marginal cost. However he makes his analysis of indivisibilities rather abstruse though extremely instructive and his solutions are incapable of being of any practical use.<sup>1</sup> That is why while the pricing of variable factors at the value of the marginal product is fundamental, it is equally fundamental that the production of output must be based on the principle of pricing the product at its marginal cost of production. This is necessary so long as we are faced with the problem of falling average costs.

### VIII

Further, the amount of loss to the community by charging a price higher than the marginal cost is again capable of being measured by further pursuing the above analysis.

It is already seen<sup>2</sup> that the utility function  $u = \phi(x_1, x_2, \dots, x_n)$  attains a maximum value of  $u$  when  $du = 0$  and  $d^2u < 0$

<sup>1</sup> *Economics of Control*, pp 174-99

<sup>2</sup> See Chapter II.

subject to the budget restriction

$$\sum p_r x_r = M$$

It is further shown that the ratio of marginal utilities to prices is a constant, which Marshall treated as the marginal utility of money.

$$\text{i.e. } \frac{u_r}{p_r} = \lambda$$

$$\text{or } u_r = \lambda p_r \quad (r = 1, 2, \dots, n) \quad (8)$$

Now, differentiating this expression with respect to  $\lambda$  we obtain

$$u_{rr} = \lambda \frac{\partial p_r}{\partial x_r} + p_r \frac{\partial \lambda}{\partial x_r} \quad (9)$$

The difference in total utility by selecting any combination  $x_1', x_2', \dots, x_n'$  other than  $x_1, x_2, \dots, x_n$  was given by

$$\begin{aligned} \delta u &= \phi(x_1 + \delta x_1, x_2 + \delta x_2, \dots, x_n + \delta x_n) \\ &\quad - \phi(x_1, x_2, \dots, x_n) \end{aligned}$$

Expanding the expression by means of the Taylor's Series for  $n$  variables, we obtain

$$\delta u = \sum_{r=1}^n u_r \delta x_r + \frac{1}{2} \sum_{r=1}^n \sum_{s=1}^n u_{rs} \delta x_r \delta x_s + \dots$$

omitting the third and higher orders which can be considered negligible.

Substituting for  $u_r$  and  $u_{rs}$  the expressions given by (8) and (9)

$$\begin{aligned} \delta u &= \sum_{r=1}^n \lambda p_r \delta x_r + \frac{1}{2} \sum_{r=1}^n \sum_{s=1}^n \left( \lambda \frac{\partial p_r}{\partial x_s} + p_r \frac{\partial \lambda}{\partial x_s} \right) \delta x_r \delta x_s \\ &\quad + \dots \\ &= \lambda \delta R + \frac{1}{2} \lambda \sum_{r=1}^n \sum_{s=1}^n \frac{\partial p_r}{\partial x_s} \delta x_r \delta x_s \\ &\quad + \frac{1}{2} \delta R \sum_{r=1}^n \frac{\partial \lambda}{\partial x_r} \delta x_r \end{aligned}$$

$$\text{Since } \sum p_r \delta x_r = \delta R$$

$$\text{Writing } \delta p_r = \sum_{s=1}^n \frac{\partial p_r}{\partial x_s} \delta x_s$$

$$\text{and } \delta\lambda = \sum_{r=1}^n \frac{\partial \lambda}{\partial x_r} dx_r$$

the above expression reduces to

$$\delta u = -\lambda \delta R + \frac{1}{2} \lambda \sum \delta p_r \delta x_r - \frac{1}{2} \delta R \delta \lambda + \dots$$

$$\text{Since } \delta R = 0$$

$$\delta u = \frac{1}{2} \lambda \sum \delta p_r \delta x_r$$

where the terms omitted are of a higher order of smalls.

The loss in satisfaction to the individual by the policy of pricing above the marginal cost is given by

$$\frac{1}{2} \lambda \sum_{r=1}^n \delta p_r \delta x_r$$

where  $\delta p_r$  and  $\delta x_r$  are the changes in price and quantity consumed by the individual of the  $r$ th commodity, and  $\lambda$  is the Marshallian marginal utility of money. This loss is compensated by no gain to the governmental revenue. The net loss in satisfaction to the community is the sum of (10) over all the individuals.

Another possibility may be envisaged wherein the state may strive to maintain the individual's aggregate satisfaction unaltered while pricing above marginal cost in which case the revenue to the government by the price increment must necessarily fall by a corresponding amount.

Since  $\delta u = -\lambda \delta R + \frac{1}{2} \lambda \sum \delta p_r \delta x_r - \frac{1}{2} \delta R \delta \lambda + \dots$  is now reduced to zero, it follows that

$$\delta R = \frac{1}{2} \sum_{r=1}^n \delta p_r \delta x_r \quad (11)$$

omitting the higher order of smalls.

The total net loss to the governmental revenue, without any compensating gain to the individual, is the sum of (11) over all the individuals of the community. Since it is admissible to make an assumption that the prices are the same for all individuals since there is equal opportunity for all to exercise choice, the total loss of revenue to the government without a



corresponding gain to the individuals is given by

$\frac{1}{2} \sum_{i=1}^n \delta p_i \delta X_i$ , where  $\delta X_i$  is the sum of  $(\delta x_i)$  over all the individuals. Similarly the total loss of satisfaction without a corresponding gain to the governmental revenue is given by

$$\frac{1}{2} \lambda \sum_{i=1}^n \delta p_i \delta X_i$$

These results follow, as already stated, on the assumption of an Index-utility function which may only be ordered. The results are *invariant* against the utility  $u$  being replaced by any arbitrary function  $F(u)$  of  $u$ . The expressions for loss of revenue or of satisfaction merely depend on the demand and supply functions which are capable of 'operational determination'. They measure the money cost to the community of the inefficiency of a system which seeks to charge a price above marginal cost instead of taking the direct course of pricing at marginal cost and meeting the fixed costs out of the public treasury.

## vii

The extensions of these findings into practical problems would indeed be of far-reaching significance. These results make it clear that the concept of the average cost of production must once and for all be given up in any policy of pricing. But this is just the concept that asserts itself in a disconcerting manner in all studies on the subject. The entire Marshallian and post-Marshallian particular equilibrium analysis<sup>1</sup> rests on the concept of 'normal profits' and the equality of price to average cost (minimum or otherwise). In another important sphere (that is, where the problem of the falling marginal costs is more patent,) namely, the study of public utilities, the belief in the axiom that each enterprise must meet its entire cost, however large, by the prices of its own products is still unshaken. 'It has become so ingrained by endless repetition that it is not even stated in connexion

<sup>1</sup> Joan Robinson, *Economics of Imperfect Competition*.

with many of the arguments it underlies.<sup>1</sup> That the axiom is wrong is amply demonstrated. The belief however has gained strength owing to its institutional association with private capital. But the danger might exist of the continuation of the belief even with the disappearance of 'private capital'.

The rejection of such a belief could arise only out of giving up the old approach to the economic problem and start thinking in terms of the new. It is Professor Hotelling's sterling contribution to have set the students of this subject to think on new lines.

<sup>1</sup> Hotelling, *op cit.* p. 256

THE PROBLEM OF THE FIRM (*Part 1*)

## i

THE method of viewing the productive activity of the community as an integrated whole throws open an entirely new set of ideas relating to the problems of a firm. The firm could be treated as an independent production unit of fundamental importance. The concept of industry is then applicable only to a group of firms producing a homogeneous commodity. Commodities which have a highly specialized market or which are technically scarce may be produced by one small firm or by few firms. But this does not generate forces either of monopoly or of oligopoly. For, the prices are fixed by the Planning Authority and production is subject to a specific rule.

A conspicuous transformation in the idea of the firm is with regard to the *entrepreneur*. The orthodox idea that the entrepreneur constitutes the firm may be entirely dispensed with. This importance of the entrepreneur as an indivisible unit is readily understandable at a time when the dominant productive activity belonged to the class of 'middle businessmen', a class which very much interested Alfred Marshall. But with the growth of large-scale enterprise the middle-class businessman is well-nigh submerged in the scene of productive activity. It may still be possible to define a firm with reference to a single manager as the indivisible unit; but this by no means exhausts the scope of the definition. In large-scale enterprises where the vertical and horizontal disintegration of production processes is ever widening, the managerial element is best treated as a variable factor, a highly specialized type of labour. In such enterprises, which

are of greater importance in modern times, the limitational factor is the technical size of the fixed equipment. Therefore it would be more correct to define the firm as a production unit where a good or goods are produced by the application of variable factors over a given stock of fixed equipment. It is true that in the long run all the factors including the fixed equipment are variable. But this is irrelevant from the viewpoint of the production of *ideal output* with a stock of fixed equipment which already exists. The long-run issues are of importance when the question of replacement or enlargement of the size of the equipment arises.

## ii

Before pursuing the analysis of the problems of the firm in a planned economy, it would be of interest to note the implications of the new definition of the firm.

First, the traditional arrangement of productive enterprises, into firms and industries, is not strictly necessary. For, the considerations governing production are not whether any one firm or industry is making (normal) 'profits' but whether the resources of the community are most economically used in accordance with the preference scales of the consumers. It is obvious that a significant part of modern enterprises would be subject to 'losses' in this sense by pricing their products at marginal costs of production. For, even in enterprises where the marginal cost is rising, it may still be below the average cost. But such considerations of 'profits' or 'losses' while eminently suited to the studies of a private grocery store have no importance whatsoever in studies of planned economy. The tenacious persistence of these considerations even in the studies of modern Public Utility pricing is an indication of the hold that 'private business principles' of the individualist economy has over the economic ideas of the present times.

Second, the concept of industry presents no difficulty whatsoever in a planned economy. The reason is there is no need for an isolated study of the

short-run and long-run equilibrium conditions of *any particular* industry. It was the inherent weakness of the Marshallian approach to make the equilibrium analysis of the firm entirely dependent on the equilibrium conditions of the industry. The inconsistencies arising out of this are well pointed out by Nicholas Kaldor.<sup>1</sup> For our purposes, the equilibrium of the firm is more fundamental; and the considerations governing production are related to the allocation of resources over the productive activity *as a whole*.

The concept of industry is needed only to bring out the functional relationship between the aggregate supply and marginal cost, and the aggregate demand and price for each good. Since the term 'industry' is used strictly to a group of firms producing a homogeneous commodity there is no difficulty whatsoever in applying our equilibrium and stability conditions of exchange. Homogeneity is an essential requirement; and goods which are differentiated from the rest belong to a distinctly individual category. Much of the intricacies of the analysis of the one-firm or few-firm industries is due to the operation of monopolistic or oligopolistic forces. In the absence of these forces the division of enterprises into monopoly, oligopoly, pliopoly and polypoly are entirely unnecessary. The only necessary distinction is between the firm and a group of firms producing a homogeneous commodity. Our equilibrium and stability conditions can be applied in both cases without any inconsistency.

iii

It can be now shown that the problem of *ideal* output for the firm can be conveniently tackled with our changed definition of the firm. The guiding principle of production is already discussed in the last chapter viz., in the interests of maximizing general welfare prices should correspond to marginal costs of production. It is also pointed out that the cost of fixed equipment ought to be met directly out of the public treasury and that fixed costs should on no

<sup>1</sup> 'Equilibrium of the Firm', *E. J.*, Vol XLIV, pp 60-76

account enter into the cost calculations of current output. The task before us is to study the implications of this rule on the internal problems of the firm.

Once the fixed equipment is installed, from the viewpoint of the firm such equipment is nothing but a *free* good, which could be utilized to the maximum advantage so long as the equipment lasts. The economic problem of the firm is to adjust the inputs of variable factors in a manner such that the output is produced in co-operation with the fixed equipment in the most *economical* manner. The resources that are precious to the community are those which have alternative uses such that if the conditions warrant resources can be withdrawn from the less advantageous position to the more advantageous one. This property, by definition, applies only to variable factors. An interesting point may however be made that the fixed equipment itself could be used to produce any of the different goods or types of goods. But in the production programme of the firm it is implied at the very beginning that the equipment is directed to produce that good for which it is suited best. Once this is determined, the equipment is meant for a specific purpose. A shift of employment of the fixed equipment from one use to another during its lifetime only means the closing down of one firm and opening another. Therefore it is perfectly correct to assume that once the fixed equipment is installed it is a *specific* factor, so long as it is intended to serve in the production of a particular defined good or goods. Ideal adjustment of resources merely involves the application of the *minimum* of variable factors to produce the *maximum* possible output. In this the problem is very much similar to the one where the individual consumer seeks to derive the greatest possible satisfaction within a given amount of time or with a given amount of energy by means of different goods and services of consumption that he can buy. The importance of the fixed equipment lies in imposing a limitation on the expansion of the firm.

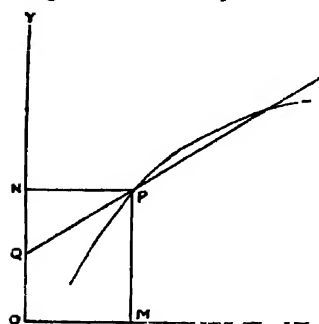
Beyond a certain output marginal costs tend to rise. And so long as the marginal costs are rising, our exchange-stability conditions tell us that there will be a definite restriction on the expansion of output. For, in all normal cases the demand curve is downward sloping and under conditions of rising marginal costs, the excess demand curve will be falling. But in the case where there is no fixed equipment, that is, where all the factors of production are freely variable such that the production function is linear homogeneous the condition of constancy of marginal costs prevails. In such a case, under atomistic competition, equilibrium of the firm would be indeterminate since the demand for the product of each firm is perfectly elastic. But in a planned economy it is consistent to assume that the demand curve is downward sloping, so that the excess demand curve will be falling in spite of constant costs. The firm will attain an equilibrium position which is determinate and stable at the point where excess demand is zero.

The case of such constant marginal costs however is only of theoretical interest. We may return to the problem of production using a given fixed equipment, after making one interesting observation.

It was argued at the beginning of the study itself that the *rationale* of planning consists in the growth of large-scale enterprises which are subject to falling marginal costs. Clearly equilibrium of the firm is indeterminate so long as costs are falling and prices follow the parametric rule. But this is just what it should be in the social interest. There could be no determinate equilibrium position so long as costs are falling, since the benefits of the enormous internal economics must be enjoyed by the community to the maximum point. This means that expansion of output must proceed till the marginal costs tend to zero, in which case the restriction of output is subject to the demand conditions ; or costs tend to be constant or begin to rise so that in either case equilibrium position is determinate and stable.

## IV

It is convenient to start the analysis of the firm with a highly simplified case of the employment of only one variable factor (in co-operation with the given fixed equipment) to produce an output of only one product. The problem of the firm is to apply the variable factor in the most economical manner. It is assumed that the parametric function of prices is in operation so that both the price of the factor and the price of the product are given i.e. fixed by the Planning Authority. The problem can be resolved diagrammatically.



Suppose the amount  $OM$  of the factor is employed and the quantity  $PM$  of output is produced. Let  $NQ$  be the value amount of the product whose value is equal to the value of  $OM$  of the factor. Then the surplus product left over is  $OQ$ . Efficient production implies that  $OQ$  should be maximized.

Equilibrium of production is attained when  $OQ$  is positive and maximum. In the above diagram  $OQ$  is obviously not the maximum.

Now, the prices of the product and the factor are given, say  $p_p$  and  $p_f$ . The market value of the amount  $OM$  of the factor is equal to the market value of the amount  $NQ$  of the product;

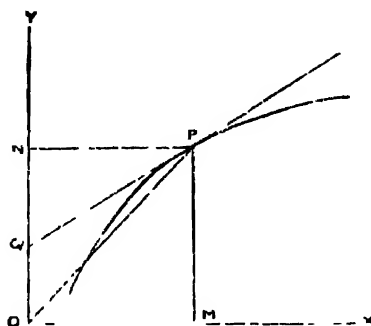
$$\text{i.e. } p_p \cdot NQ = p_f \cdot NP$$

$$\text{or } \frac{p_p}{p_f} = \frac{NQ}{NP} = \text{slope of } PQ$$

Therefore  $PQ$  is the price-line which measures the ratio of the prices of the factor and the product. With increasing amount of the factor employed, the amount of the product will increase, as pointed out by the production curve. But the price-line will correspond-



ingly move upwards without altering its slope since prices have not changed. The position of maximum surplus is given by the point at which the price-line touches the production curve, as in the diagram.



Therefore, the conditions of equilibrium are that the price-line  $PQ$  must touch the production curve at the point  $P$ . That is, the slope of the production curve at  $P$  must be identical with the price-line. But the slope of the production curve is the increment of the product obtained by a small increment of the factor, that is the marginal product of the factor. Hence, the condition of equilibrium is that the price of the factor must be equal to the value of its marginal product or the price of the product must be equal to the marginal cost of production.

Again in order that  $OQ$  is maximum, the production curve must be rising and convex to the origin (if the curve were concave  $OQ$  would be minimum). This means that the rate at which the factor is transformed into product is diminishing, which is just the law of diminishing marginal productivity. Employing the terminology of Professor Hicks, the price ratio must correspond to the *marginal rate of transformation* at the point of equilibrium. For the equilibrium to be stable, the marginal rate of transformation must be diminishing. These conditions are symmetrical with the conditions of stable equilibrium for the

consumer viz. the price-line must touch the indifference curve and the indifference curve must be a falling curve convex to the origin.

These results can be put into a neat algebraic form. Suppose the prices of the product and the factor are  $p_x$  and  $p_a$ . To produce  $x$  units of output  $a$  units of the factor are employed. The production function is given by  $x = f(a)$ . The cost in terms of the units of output of employing  $a$  units of input is  $\frac{ap_a}{p_x}$ .

Ideal output is obtained when  $(x - \frac{ap_a}{p_x})$  is maximized.

$$\text{That is } \frac{d}{da} \left( x - \frac{ap_a}{p_x} \right) = 0$$

$$\text{and } \frac{d^2}{da^2} \left( x - \frac{ap_a}{p_x} \right) < 0$$

$$\text{i.e. } \frac{dx}{da} - \frac{p_a}{p_x} = 0 \quad \text{and} \quad \frac{d^2x}{da^2} < 0$$

$$\text{i.e. } \frac{dx}{da} = \frac{p_a}{p_x} \quad \text{and} \quad \frac{d^2x}{da^2} < 0$$

The first condition refers to the equality between the price-ratio and the marginal product; and the second condition refers to the diminishing rate of marginal transformation which means diminishing product or rising marginal cost.

$$\text{Since } \frac{p_a}{p_x} = \frac{dx}{da}$$

price of the factor,  $p_a = \frac{dx}{da} \cdot p_x =$  value of the marginal product of the factor.

And price of the product  $p_x = p_a / \frac{dx}{da} =$  marginal cost of employing the factor to produce unit output.

The considerations of average cost are inessential to our purpose. It may however be seen that with

the elimination of the fixed equipment from our consideration, the conditions of the equilibrium of the firm, viz. the equality of the price of the product and marginal cost of production, and the price of the factor and the value of its marginal product exactly conform to the conditions laid down in the interests of maximum general welfare.

## v

We may now proceed to the complex case where more than one variable factor is employed to produce more than one product. The analysis follows on the important assumption that the fixed equipment of the firm imposes a limitation on an indefinite expansion of output, that beyond a certain point marginal costs tend to rise with the emergence of dis-economies of production.

In extending our analysis to the multi-factor multi-product firm we are approaching the reality a degree closer. That usually more than one variable factor is needed even for the production of a single product is obvious. But the equally important fact that a firm more often produces more than one product has received little attention so far, perhaps due to the seemingly complicated nature of the problem. It could however be shown that the multi-product firm offers no more difficulty than the single-product firm. The input-output relationship brings into clear relief the symmetrically opposite characteristics of products and factors. The unity of economic analysis consists in that all economic problems confronting the individual or the community are either problems of maximization of benefit or its counterpart, the minimization of sacrifice.

Consider a firm utilizing its fixed equipment to transform the factors  $A, B, C \dots$  into products  $X, Y, Z \dots$ . In the one variable factor-one product case, we could draw a production curve on a plane surface showing the diminishing rate of transformation of the factor into the product. In the case of only two factors entering into production, it would be possible

to draw a constant product curve showing the various proportions with which two factors could be combined in order to produce a constant output. Similarly, in the general multi-factor multi-product case, there could be traced a single relation between various quantities of factors and various quantities of products. Geometrically this may be represented by a surface in many dimensions. Given this general relation, the quantities of all factors and the quantities of all products but one, the maximum amount that could be produced of the remaining product could be easily determined. Similarly, given the quantities of all products and all factors but one, the minimum quantity of the factor needed in the production of all the given products could be easily solved.

The planning of production on the part of the firm might appear to present enormous complexities since there are many factors and many products involved in the production process. But all these complexities can be reduced into three types (or combination of any of the three types) viz (i) one product may be substituted for another at the margin, (ii) one factor may be substituted for another and (iii) one product and one factor may vary together in the same direction.

The problem to the firm is, given the prices of factors and of products and the quantities of factors it will employ and the quantities of products it will produce, the surplus after paying off all the factors must be maximized. The analysis of this problem can be resolved into three cases. It would be convenient to start with the case of only two variables since the analysis is capable of neat geometric representation. The results can be extended to cases of more than two variables.

First, consider the productive possibilities of a given supply of the factors with reference to the production of two goods. The interest of the firm now lies merely in varying the proportion in which the two goods are produced. If a given quantity  $x$  of the

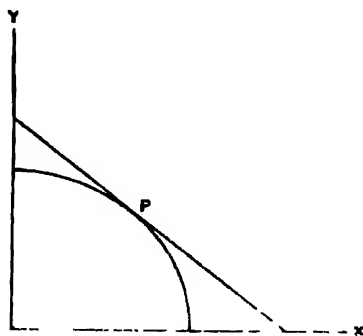
good  $X$  is produced, the fixed stock of factors could be adjusted to produce the largest amount  $y$  of the good  $Y$  compatible with the quantity  $x$ . Here  $y$  is a single-valued monotonic decreasing function of  $x$ . It follows that the variables  $x$  and  $y$  stand in inverse relation to each other. We can state the implicit relation between the output of the two goods by the function

$$F(x, y) = 0$$

which gives  $y = f(x)$  and  $x = \phi(y)$

where  $f$  and  $\phi$  are single valued decreasing functions.

The alternative productive possibilities given by the function  $F(x, y) = 0$  can be represented in a horizontal plane by a falling *transformation curve* which in the normal case is concave to the origin since increase in the production of  $X$  entails a decrease in  $Y$  at an increasing rate owing to the principle of diminishing marginal productivity. Given the market prices of the two goods  $p_x$  and  $p_y$ , the most advantageous proportion of the two products is given by the point at which the price-



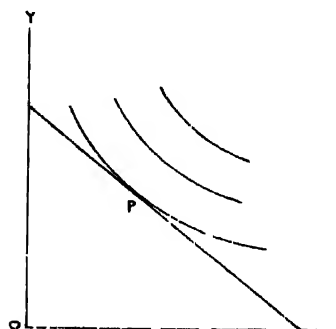
line touches the transformation curve. That is, the price ratio must equal the slope of the transformation curve which measures the technical marginal rate of substitution at the equilibrium position. In order that the proportion gives the maximum advantage (and not the minimum) the

curve must be convex to the origin. That is, the marginal rate of substitution must be increasing. In other words, marginal costs must be rising.

Next, consider the case where the two factors are combined to produce a constant amount of a single good. Denoting the constant product condition by the production function :

$$x = f(a, b) = \text{constant},$$

graphically a production surface can be drawn referred to the axes  $Oa$  and  $Ob$  horizontally and  $Ox$  vertically. The contours of the production surface comprise of a system of curves in the plane surface  $Oab$  which may be termed the constant product curves defined by  $f(a, b) = \text{constant}$ . The curves are continuous and non-intersecting



$$x = f(a, b) = \text{constant}.$$

Differentiating and denoting the marginal

products by  $f_a = \frac{dx}{da}$

and  $f_b = \frac{dx}{db}$

$$f_a da + f_b db = 0$$

$$\text{i.e. } \frac{db}{da} = -\frac{f_a}{f_b}$$

In the normal case, the tangent gradient of the constant product curve  $\frac{db}{da}$  is negative. It is clear that  $\frac{db}{da}$

denotes the marginal rate of substitution of the factor  $B$  for the factor  $A$  in the production of the good  $X$ .

Once again, for the equilibrium position, the price-line, of the factors must touch the constant product curve. That is, the price ratio of the factors must be equal to their marginal rate of substitution (or the ratio of their marginal products). The stability condition is that the total value of the factors used must be minimum. That is, the curve must be convex to the origin, implying the principle of diminishing marginal rate of substitution for the factors.

Now, the third case of the transformation of one factor into one product has been already discussed in the earlier part of this chapter. It is shown that the equilibrium condition is that price ratio of factor and product must be equal to the marginal rate of

transformation (or the marginal product of the factor) Equilibrium is stable so long as the rate of transformation is declining, that is, the marginal product is diminishing.

The analysis may be easily extended to cases of more than two factors and two products, since the conditions of equilibrium and stability must hold good with reference to any pair of products, any pair of factors, or any set of factor and product.

Corresponding to the general condition of equality between price and marginal cost, three sets of conditions may be laid down guiding the firm in the production of an ideal output.

First, the price ratio between any two products must equal the marginal rate of substitution between the two products. It may be incidentally observed that the optimum proportion of the two products that puts the consumer in the most preferred position is again given by the equality between the price ratio and his own marginal rate of substitution of one good for the other. Therefore, under equilibrium conditions the technical and the consumer marginal rates of substitution are identical and equal to the price ratio.

Second, the price ratio between any two factors must equal their marginal rate of substitution or the ratio of their marginal productivities.

Third, the price ratio between any factor and any product must equal the marginal rate of transformation of the factor into the product (that is, the marginal product of the factor in terms of this product).

The stability conditions are :

(i) The substitution of one product for the other must be subject to the condition of increasing marginal rate of substitution, that is, increasing marginal cost in terms of the other product.

(ii) The substitution of one factor for another must be subject to the condition of diminishing marginal rate of substitution.

(iii) The transformation of a factor into a product must be subject to the condition of

diminishing marginal rate of transformation (that is, diminishing marginal productivity of the factor).

These conditions must hold true not only for individual substitutions and transformations but for group substitutions and transformations as well. For any pair of groups of products the marginal rate of substitution must be increasing, for any pair of groups of factors the marginal rate of substitution must be decreasing and the transformation of a group of factors into a group of products must obey the condition of diminishing marginal rate of transformation.

The entire set of conditions can be put into a single algebraic expression. Consider the firm as employing various quantities of factors such as  $a_1, a_2, a_3 \dots a_m$  to produce quantities of products  $x_{m+1}, x_{m+2}, \dots, x_n$ . The ideal adjustment of resources is obtained when the surplus arising as a difference between the value of the aggregate output and the cost of employing factors is maximized. Denoting the surplus by  $S$  and the prices of the factors by  $p_1, p_2, \dots, p_m$  and of the products by  $p_{m+1}, p_{m+2}, \dots, p_n$  we have the relation

$$S = - p_1 a_1 - p_2 a_2 - \dots - p_m a_m \\ + p_{m+1} x_{m+1} + p_{m+2} x_{m+2} + \dots + p_n x_n$$

From the point of view of the firm, the difference between the factor and the product is only a difference in sign. Therefore it would be convenient to treat the factors as negative products and write  $x_r$  for  $-a_r$  ( $r = 1, 2, \dots, m$ ).

The firm seeks to maximize

$$S = \sum_{r=1}^n p_r x_r$$

subject to the condition  $f(x_1, x_2, \dots, x_n) = 0$  which shows the implicit production relationship between product and factors. This implicit function is arbitrary and may assume any value  $F(f)$  of  $f$ . It could be termed the Index Production Function.

By applying the Lagrange Multiplier, we can write for the expression  $S$  ( $S - \lambda f$ )



This is maximized when  $d(S - \lambda f) = 0$   
and  $d^2(S - \lambda f) < 0$

To obtain the first condition, differentiating  $(S - \lambda f)$  with respect to  $x$ , we obtain  $(p_r - \lambda f_r) = 0$

$$\text{i.e.} \quad \frac{p_r}{f_r} = \lambda$$

We have  $(n - 1)$  such equations which together with the production function will determine the  $n$  quantities of factors and products.

Now for the values of  $r$  from 1 to  $m$  the ratios indicate our second equilibrium condition viz. the price ratio of the factors must equal the ratio of their marginal productivities or their marginal rate of substitution

$$\text{i.e.} \quad \frac{p_1}{p_2} = \frac{f_1}{f_2} \quad \text{etc., from 1 to } m.$$

For values of  $r$  from  $m + 1$  to  $n$ , the ratios indicate our first equilibrium condition viz. the price ratio must be equal to their marginal rate of substitution of one product for another

$$\text{i.e.} \quad \frac{p_{m+1}}{p_{m+2}} = \frac{f_{m+1}}{f_{m+2}} \quad \text{etc., from } m+1 \text{ to } n$$

Our third condition can be found by equating any of the ratios from 1 to  $m$  to any of the ratios from  $m + 1$  to  $n$  at random. For instance,

$$\frac{p_1}{f_1} = \frac{p_n}{f_n}$$

$$\text{i.e.} \quad \frac{p_1}{p_n} = \frac{f_1}{f_n}$$

i.e. the price ratio between any factor and any product must equal the marginal product of the factor in terms to the product in question.

## vi

So far we have been concerned only with the *static* problem of the firm which consisted merely in the selection of certain quantities of products and

factors. But the firm is concerned with another, equally important problem viz. planning production through time. That is, the firm has to decide upon the most appropriate inputs and outputs at the different intervals of time during the lifetime of the equipment. The problem is one of *dynamic* maximizing of the production surplus. In attacking this problem our static analysis of many factors and many products will be extremely useful.

For analytical convenience, consider only one physical kind of output, say  $X$ . The production plan of the firm is to arrive at a correct selection of a number of different outputs (output of  $X$  at different dates), which yields the maximum surplus. For the firm a certain range of alternatives are open. As in the static case, the limitation imposed on indefinite expansion is purely technical, viz. the limited capacity and life of the fixed equipment. This limitation which gives a specific relationship between the inputs and outputs at different dates can be stated in the form of an implicit production function. If the magnitudes of all inputs at different dates and all outputs but one are given, the production function will give the maximum output possible of the remaining date, similarly, if all outputs and all inputs but one are given, the production function will give the minimum input needed on the remaining date. Since the firm has to work under this technical limitation, changes in production plan might involve (i) substitution of the output of one date for another, (ii) substitution of the input of one date for another and (iii) the variation of one input and one output simultaneously.

The establishment of the criterion for the appropriate selection of the quantities during different dates is quite simple. The criterion should be in terms of the capitalized value of stream of surpluses what we may call the capitalized value of the Production Plan.<sup>1</sup> The problem of maximizing the present value of the production plan is identical with the

<sup>1</sup> Hicks, *op. cit.*, p 195

problem of maximizing the production surplus under the static conditions which we have previously analysed. Only outputs at different dates are to be considered as different outputs; and inputs at different dates are to be regarded as different inputs. But in building up the equilibrium conditions, the price ratios of the factors and the products must be replaced by the ratios of discounted prices. The meaning and method of discounting prices will be discussed in a later chapter.

The conditions of equilibrium and stability are again identical. First, the marginal rate of substitution between outputs of any two dates must be equal to the ratio of their discounted prices. Second, the marginal rate of substitution between inputs of any two dates must be equal to the ratio of their discounted prices. And, third, the marginal rate of transformation of any input into any output must be equal to the ratio of their discounted prices.

The stability conditions are:

- (i) The marginal rate of substitution between outputs at the different dates must be increasing.
- (ii) The marginal rate of substitution between inputs must be diminishing.
- (iii) The marginal rate of transformation of an input into an output must be diminishing.

These conditions are laid out on the assumption that the stock of fixed equipment remains unimpaired. But this assumption may be relaxed without in any way affecting our conclusions. For, the wearing out of fixed equipment may be treated as equivalent to a corresponding output produced during the period in which it is wearing out. The production plan would terminate at the moment when the fixed equipment is scrapped or reduced to zero.

Throughout this discussion, the concept of average costs has not at all been involved. This is in strict accordance with the conclusions we have reached in the previous chapter. In the individualist economy, the equilibrium and stability conditions under perfect competition involve rising average costs. This is

necessary in order that the firm may avoid losses. In a planned economy where the fixed equipment entails no charge on the firm, average cost plays no part in the determination of the ideal output. But in problems of replacement or installation of new fixed equipment the concept of minimum average cost could be used to some advantage. This point will be taken up in detail in the next chapter.

THE PROBLEM OF THE FIRM (*Part 2*)

WE may now take up the problem of the fixed equipment in a planned economy which has provided a subject matter for lively discussion during recent years. To bring out the essentials of the problem, it is necessary to analyse the distinguishing characteristics of a firm.

## 1

The firm has been defined as a production unit wherein variable factors are utilized in co-operation with a stock of fixed equipment to produce a good or a set of goods. The size of the firm depends on the size of the fixed equipment which imposes a definite limitation on the expansion of output. In a good number of cases the increasing difficulty of the management and control by a single manager may impose a limitation on the size of the firm. In other instances wherein large scale methods of production are employed, the limitation for indefinite expansion is imposed by the existence of huge indivisible units of technical equipment in the form of machinery, buildings etc. But in either case, due to the existence of fixed equipment costs per unit of output will be falling upto a certain output and will begin to rise if production is extended beyond that point of minimum average cost. As a matter of fact, in enterprises which have a technically huge size of fixed equipment, the point of minimum average cost is seldom reached.

It has been clearly demonstrated in the last chapter that the *ideal* output that the firm should produce with a given stock of fixed equipment is given by the position at which the price of the product is

equal to the marginal cost of production. It has been further shown that this marginal-cost-price equality also implies the *ideal* adjustment of inputs of variable factors. Fixed equipment was intentionally kept out of account as an irrelevant consideration. That was correct in so far as the problem was one of *ideal* allocation of variable factors, granted the co-operation of fixed equipment which existed independently. The problem now is to examine the considerations that enter into the determination of the correct size of the fixed equipment.

In this chapter attention is confined to the problem of the firm which satisfies the equilibrium and stability conditions of production. That is, we assume the condition of rising marginal costs. But the importance of fixed equipment is much greater in enterprises which are technically so huge that even for significantly larger and larger outputs the marginal costs continue to fall and almost tend to zero. In a planned economy such enterprises are of greater social significance. This problem will be taken up at length in the next chapter

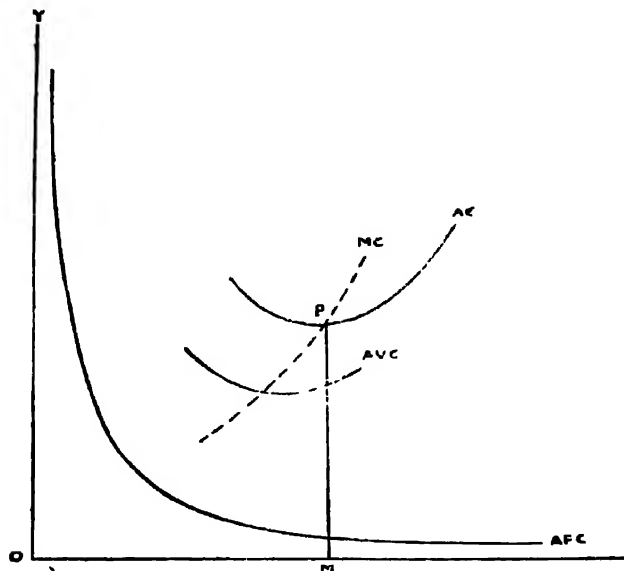
## ii

The cost curves that have been made familiar to us by the recent studies of particular equilibrium analysis are of great service in elucidating the problem of the fixed equipment.

The total cost of production of a firm may be conveniently resolved into fixed cost and variable cost. Variable cost refers to the expense incurred in producing an additional unit of output. The costs that exist independent of the production of this additional unit could be grouped under the fixed cost or the cost of fixed equipment. Obviously, the share of unit output of this fixed cost goes on falling as the production of output expands. The average fixed cost curve is a rectangular hyperbola with the output and price axes as its asymptotes.

It is clear from the previous chapter that the **marginal (variable) costs** must be rising for equilibrium

to be stable. When the marginal (variable) costs exceed the average variable costs, the latter also will begin to rise. The average total cost is merely the aggregate of average fixed cost and the average variable cost for different outputs. It follows from the property of average-marginal relationships that the marginal cost curve will cut both the average variable cost and the average (total) cost curves at their minimum points.

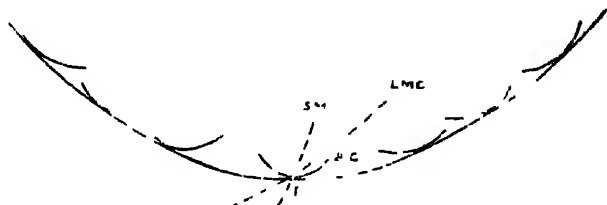


The optimum position is given by the point  $P$  which indicates the minimum average cost of production. Price is equal to the marginal cost of production; and the cost of fixed equipment is completely recovered by selling  $OM$  units at the price  $PM$ . The individualist conception of pricing would naturally insist on this position where price = marginal cost = minimum average cost as the optimum.

So far we have traced the cost curves assuming a given fixed equipment. But there might be a number

of cost curves each distinguished from the other by the nature and size of the fixed equipment. It is clear that in the long-run *ideal* production implies the selection of that type of fixed equipment which involves the smallest (total) cost of production.

This interrelationship between the long-run and the short-run conditions is best illustrated by A. P. Lerner's envelope.<sup>1</sup> The long-run cost conditions may again be falling or at a minimum or rising for relevant scales of production.



The small U shaped curves are the short-term average cost curves showing the cost conditions for different sizes of fixed equipment. They are so arranged as to show that the envelope which is the long-period average cost curve itself is U shaped, suggesting that firms situated near the centre can produce more cheaply than smaller or larger plants situated on either side. The long-run ideal position of equilibrium is at the point *P* which is also the short run ideal. Average costs, short-term and long-term, are at a minimum and are equal to long-run and short-run marginal cost. This is the position of equilibrium under *perfect competition* when the demand curve is horizontal touching the average cost curves at *P*.

This *ideal* position is so fascinating that writers on socialist pricing have this invariably in their mind when they suggest or till recently suggested that while price must equal the marginal cost of production, it must also equal the short-run average cost and the

<sup>1</sup> Lerner, "Statics and Dynamics in Socialist Economics", *E J*, Vol XLVII, p 281 and see our Appendix



long-run marginal cost. It is beyond dispute that the appropriate size of the firm ought to satisfy these conditions. But the very fact that the *ideal* position is attained, only where all the technical and economic requirements of perfect competition exist points out the impossibility of its realization in the ordinary changing world. A great amount of knowledge and foresight and constancy of the economic situation are necessary to postulate such an ideal position. That planned economy is better suited to equip itself with the necessary knowledge and foresight is perhaps a strong point in its support.

iii

There is indeed perfect sense in the statement that while price must equal marginal cost, it must also equal the minimum average cost in order to establish that the firm has functioned in the most efficient manner. But to support the fundamental rule of equalizing the price and marginal cost with another rule pertaining to the minimum average cost is apt to be misleading. For, the concept of minimum average cost is of social significance not with regard to the utilization of a given fixed equipment but with regard to the installation of new fixed equipment.

The principle of economic allocation of resources applies to the construction of fixed equipment as well. That means the guiding consideration in installing the fixed equipment is that it should be utilized to the point of maximum advantage. The competitive criterion for this is that price of the product must equal the minimum average cost.

In actual practice this equality is seldom established in the *ex post* sense. It is only under the theoretical abstraction of perfect competition that the estimates made at the commencement of the production process turn out to be absolutely correct. However, such estimates are very necessary. In deciding upon the size and nature of the fixed equipment, the principal consideration should be that the expected net returns of the equipment exceeds the costs incurred on that

account. The ideal size would be decided by the position at which the actual costs and actual returns would be exactly equal. With regard to this difficult problem of fixing the appropriate size of the equipment J. E. Meade has provided a neat rule: that a greater amount of fixed capital should be invested so long as the annual interest on the capital plus the annual cost of repair, depreciation etc. is less than the price of any additional output expected from the investment plus the price of any existing prime factors which it is expected to save minus the price of any additional prime factors which it is expected to take on as a result of the investment.<sup>1</sup>

The formulation of the rule suggests a ready course for each firm to adopt when the problem of new equipment comes up. The guiding criterion is one of balancing costs and returns. The costs of the new equipment may be classified into amortization, interest charges and maintenance costs. The net increase in returns due to the application of the additional equipment is measured by the price of additional output expected to be produced plus the price of variable factors expected to be saved minus the price of the additional variable factors expected to be absorbed as a result of the new investment. Identical considerations decide the starting of an altogether new enterprise.

#### IX

Our entire approach to the problem is one of looking forward. Once the equipment is installed the problem of fixed costs disappears once and for all. The only costs taken into account are costs incurred in producing additional units of output. This attitude is of eminent help even in tackling the problem of renewals and replacements of small items. According to our rule any marginal item of investment must be undertaken if the expected price of the service it will offer discounted over the relevant period at the

<sup>1</sup> J. E. Meade, *Price and Output Policy of State Enterprise*, F. J. of LIVL p. 322. This rule is not intended for large investments.

appropriate interest rate exceeds the cost of introducing it. With this rule, the short-run and the long-run problems are brought under one standard criterion<sup>1</sup>

While the fixed equipment is in general in an efficient condition, it is economical to renew such small items as wear out fast.<sup>2</sup> This is advantageous as long as the returns out of these exceed the cost of such renewals. But as the life of the fixed equipment advances, the items that wear out increase in number and in a short time the problem of replacing the entire equipment might face the firm. Since this would be absurd unless it is inevitable, the newly replaced items have a shorter and shorter duration of service. The stage will arrive when the returns fall short of the cost of replacement and the entire old equipment is scrapped. The new equipment is installed in accordance with the considerations discussed in the previous section.

#### V

The question of fixed equipment presents a difficulty *unique* to planned economy owing to the general policy of pricing at marginal cost. In individualist enterprises, market imperfection creates a situation where the demand curve for the firm is downward sloping. In such cases, equilibrium is stable even though average costs are falling so long as price is equal to average cost and marginal revenue is equal to marginal cost. But this tangency condition stabilizes the production of output at a point below the optimum, thereby generating a certain amount of excess capacity. The elimination of this excess capacity is a problem under rationalization that has evoked considerable discussion.

This position of the firm below the optimum may as well confront planned economy. Since the market conditions decide the fixing of the parametric price it might well mean that the price that is fixed is below

<sup>1</sup> Maurice Dobb, *Political Economy and Capitalism*, p. 291

<sup>2</sup> See in particular N. Kaldor, "Market Imperfection and Excess Capacity", *E. J.*, Vol. II, pp. 33-50. R. F. Kahn, "Notes on Ideal Output," *E. J.*, Vol. XLV, pp. 1-19. C. L. Paine, "Rationalisation and Excess Capacity" *E. J.*, Vol. III, pp. 48-60



while using a given fixed equipment. The fact that a firm is working under 'loss' offers no budgetary difficulty to a planned economy since 'losses' in one must be balanced by 'gains' elsewhere since all the income accruing out of the production of goods and services goes into the coffers of the state.<sup>1</sup> But these questions are really important when the problem of reorganization comes up. Clearly there is an advantage in reorganizing the size of the firm in the light of previous experience such that the new equipment may be expected to operate at the point of minimum average cost, given the demand conditions.<sup>2</sup> In this instance the firm has proved to be too big and the appropriate contraction is warranted.

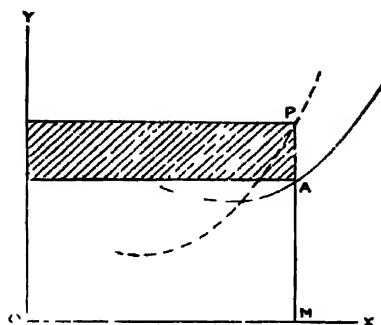
## VI

There is another interesting departure of the firm from the long run *ideal* which is a feature (except in rare conditions of abnormal monopoly) exclusive to planned economy. This is a position where production is extended beyond the optimum point though, in strict accordance with the principle of marginal-cost price equality. The high conditions of demand may warrant an expansion of output in spite of rising average costs. This is a feature exclusive to the planned economy because under conditions of perfect competition such a situation would give rise to abnormal profits and entry of new firms and under imperfect competition output is always below the optimum owing to the tangency condition between falling demand curve and average cost curve.

In a planned economy this might be a common feature among ordinary enterprises. For the firm this position has a special attraction since total revenue far exceeds the total outlay. There is a clear surplus which may be termed *rent* that accrues to the firm after meeting the entire cost of production.

<sup>1</sup> F. M. I. Durbin, "Economic Calculus in Planned Economy", *E. J.*, Vol. XLVI, p. 685.

<sup>2</sup> This is a particular case of a more fundamental criterion. See pp. 72-4.



The magnitude of the surplus is given by the difference between marginal cost and average cost multiplied by the output i.e. in the diagram, by area  $PA \times OM$ .

This position is agreeable in perfect social interest in so far as the utilization of existing equipment is concerned. It is true that the firm is enjoying an unnecessary surplus. But this *rent* should not be confused with the competitive concept of abnormal profits. The fixed equipment is subject to increasing strain and production is undertaken subject to diseconomies. But still the output that is being produced is in strict accordance with the requirements indicated by the consumer's preferences.

If the demand conditions persist in such cases the problem of reorganization is however urgent. The size of the firm is too small. The high *rent* is an indication of the potential demand and it is in the interest of the community to enlarge the size of equipment, so that larger economies of production may be utilized. In doing so, increased demand will be satisfied at lower cost conditions which means that variable resources are being employed in a more economical manner. Once again the objective of reorganization is to attain the long-run position of lowest average cost subject to the demand conditions. If the cost conditions follow the course of a wavy curve, this may be achieved by any of the subsequent minimum points. If the high state of demand warrants a complete reorganization, the new technical plant can be of a bigger size giving a lower minimum point of average cost. Therefore the element of rent is of

great significance in guiding the future course of production in a planned economy. With adequate knowledge of the potential demand, it is always worthwhile to launch upon bigger and bigger enterprises which may confer far-reaching benefits to the community. Potential demand has to be balanced against potential economies.<sup>1</sup>

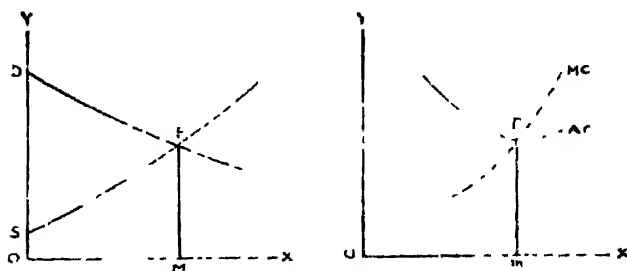
## vii

In the above presentation we have made some implicit assumptions that must now come to the surface. In retaining the *minimum average cost* as the long-run norm of production, we have taken for granted certain characteristics that are exclusive to perfect competition. For analytical convenience in presenting the problem, this was necessary, but in tackling the problem of large-scale equipment under modern conditions of production, these assumptions have to be discarded since they no longer hold true. A more fundamental criterion of which the *minimum average cost* is only a particular manifestation has to be established.

It is the special distinction of perfect competition that it ensures complete identity between the criterion of maximum social advantage and the criterion of successful private production. Because of this identity, the fundamental criterion of social benefit has been submerged and the commercial conditions of production under minimum average cost has been given a greater degree of prominence. This is indeed in keeping with the requirements of private enterprise, run on business principles of profit and loss. But our object of studying the conditions of maximum general welfare should bring into relief the social criterion which is in fact the only fundamental criterion. When the conditions of perfect competition do not exist (and this applies to a large sector of modern enterprises), the competitive criterion is both useless and misleading. The fundamental *social* criterion must be sought directly in all such cases.

<sup>1</sup> Young, "Increasing Returns and Economic Progress", *E. J.*, Vol XXXVIII, pp. 530-7.

The social criterion is that the *net* advantage to the community by undertaking any productive activity must be maximized. This net advantage is measured by the difference between the total benefit to the community by the production of the commodity and its total cost of production to the community. Now it is the well-known property of the demand curve that the area under it measures the total benefit to the community by the consumption of that commodity. This total benefit is measured by the aggregate of maximum prices that would be paid to the individual units of the commodity. The area under the marginal cost curve measures the total cost of production. Therefore, for any given output, the difference between these two areas measures the net social advantage. It is in the social interest that this ought to be maximized. And this is just what is achieved under conditions of perfect competition.



This is indicated in the Dupuit diagram by the area *DPS* which is maximum at the equilibrium position *P* where demand equals supply. The supply curve under perfect competition coincides with the marginal cost curve. Further, each firm under perfect competition is situated at the optimum position at which marginal cost is equal to minimum average cost.<sup>1</sup> Therefore the equilibrium condition of the industry that brings about the equality between price and marginal cost also brings about the equality between

<sup>1</sup> E. Chamberlin, *The Theory of Monopolistic Competition*, Ch II



price and minimum average cost for each firm. The former is the social criterion that maximizes the net social benefit. The latter is the private criterion that ensures full recovery of the total cost of production by the sale of output. The two are identical under perfect competition. But it is the private criterion that is more relevant to producers under *laissez-faire*, and that is why the equality between price and minimum average cost is put forward as an adequate condition even from the view point of maximum general welfare.

This identity holds true only under conditions of perfect competition for it is only then that the supply curve is identical with the marginal cost curve and that price is equal to *minimum* average cost. That perfect competition does not exist in the modern economic system is obvious. Therefore it is in the strict interests of the study of general welfare that the private criterion must be put aside and attention concentrated on the *social* criterion of maximizing the net benefit to the community.

#### viii

The significance of the social criterion becomes all the more clear when we further examine the properties of perfect competition which we assumed while putting forward the *minimum average cost* approach. In stating Meade's formulation of the rule for new fixed equipment, the effect of increase in output on the price of the product and of increase in input on the price of the factor was completely neglected. This is in conformity with the marginal principle which implies increment or decrement only of an *infinitesimal* order. Under perfect competition such small increments or decrements at the margin are supposed to have no influence on the price of the product or the factor. Therefore it can safely be assumed that the addition to utility by the increased output (as a result of the new equipment) is measured by the price of the product and the loss of utility due to contraction of output elsewhere is measured

by the price of the factor. These assumptions are completely justified with regard to variable products or factors which are capable of perfect divisibility. But by definition fixed equipment is an indivisible lump whose addition or withdrawal brings about a significant change in the value of output and input. Here refinements of marginal analysis break down in so far as the infinitesimal concept cannot be applied to indivisible lumps without making incorrect assumptions. The *social* criterion comes into its own not only in pointing a way out but also in introducing many other factors that have to be reckoned with in estimating the net benefit due to the application of a new fixed equipment.

#### IX

By definition the introduction of an indivisible unit results in the absorption of a considerable portion of variable factors which were being employed elsewhere, and in the emergence of a significant increase in the output of the commodity. The magnitude of absorption of variable factors or of increase in the output depend on the size of the indivisible lump and the technical conditions of production. In so far as the indivisible units are not of a significant size it may be possible, or perhaps practicable, to apply the rule formulated by Meade for small-sized investments. In assuming that the introduction of the indivisible unit leaves the price of the product and the factor unaffected, we are only reducing the indivisibility into insignificance which is just what is expected to happen under perfect competition. If it is possible to establish a general rule for all indivisible units, significant or insignificant, the latter may be treated as a special case of the rule where atomistic criterion can be applied without serious error.

If the introduction of the indivisible unit were to enlarge the output significantly, then it is impossible to apply the simple input criterion viz., the price of the factor must be equal to the value of the marginal product. For, the application of one unit of an

indivisible lump does not merely result in a small increment of the output in which case the value of the increased output could be measured by the price the consumers are willing to pay for it. It results in increasing the output to a significant extent and the choice before the firm is to do without the indivisible unit and forego any possibility of increasing the output or to introduce the indivisible unit and enlarge the output to a significant degree. There is no middle course. In this case, the total gross benefit to the community is not adequately measured by the price the consumers are willing to pay for the last unit multiplied by the number of units of output. It is much more than that and is measured by the aggregate of what the consumers are prepared to pay for each individual small unit of the increased output rather than go without it. This is so because there would be no addition to the output whatsoever without the introduction of the new indivisible lump and therefore every unit added to the output must be valued at what the consumers are willing to pay for that particular unit. To measure the total gross benefit by the utilization of the indivisible factor, the area under the relevant range of the demand curve for the product must be integrated. If we assume that the increased output is sold at the price the consumers are willing to pay for the last unit, then the difference between the total gross benefit and this sum measures the consumers' surplus due to the buying of the increased output at the uniform lowest price. To measure the total *net* benefit to the community by the enlarged output due to the use of the indivisible factor, the relevant cost of producing the increased output must be deducted. This is measured by the value to consumers of the output which is foregone by drawing these factors away from their alternative sources of employment. If the factors were drawn at the margin from a number of alternative uses then the cost of output could be measured by the price of the factors involved. But if significant indivisible

lumps of factors are drawn for other industries, then the cost is appropriately measured by the area under relevant range of the demand curve in the industry or industries from which the factors are drawn. Another important item must be added into our cost calculation. In computing the social cost of the increased output in this manner, we have to deduct the relevant amount of producer's surplus that accrues to the owners of the factors due to the rise in their prices necessitated by the increased demand for them. This is because if the absorption of the factor was a steady process and each unit was paid just what it was earning elsewhere, the factors could still have participated in the production of the output. That it is not possible to employ in that manner gives rise to surplus earnings to the owners of the factors.

It is clear that the Dupuit diagram indicates the correct social criterion, viz. maximization of the difference between the total benefit and total cost to the community of increasing a given quantity of output. So long as the application of an indivisible unit leads to the increase in benefit greater than the increase in cost, there is clear advantage to the community in its application. The appropriate method of estimating the benefit and the cost is discussed above and it is seen that it involves *estimates* of different magnitudes.

x

In the light of the above analysis one can understand the dilemma involved in deciding upon the installation of a new large indivisible unit. That the application of the indivisible unit in the production process will affect prices of the product or of the factor or of both is obvious. Prior to the application of the indivisible lump the price of the product is higher and the price of the variable factors lower. Taking into account only this situation, it may be eminently worthwhile to launch upon the application of the new indivisible unit because the estimated social benefit

(the existing price into the increased output) may seem to exceed considerably the social cost (the price of the indivisible factor plus the prices of the co-operating factors). But when the indivisible unit is applied, the increased output lowers down the demand price and the increased input might raise the prices of the variable factors which are drawn from alternative sources of employment. When the increased output is produced, if the actual benefit and cost are evaluated at the lowered product price and the increased factor-price, the actual social benefit might fall short of the social cost. Prior to the application of the indivisible unit, the situation called for its application. At the end of the production process, the application has proved a mistake. This inconsistency arises because of our primary mistake in the process of evaluating benefit and cost.<sup>1</sup>

## xi

The correct principle for the valuation of the increment in benefit and in cost in all such applications of the significantly large indivisible units is put forward by J. M. Fleming: "The right course is to value the increment of output at the price expected to prevail after the change *plus* the surplus accruing from the fall in product prices to the consumers of the increment of output, and to value the increment of factor cost at the factor prices prevailing after the change *less* the surplus accruing from the rise in factor prices to the owners of the additional factors required to produce the increment of output."<sup>2</sup> This enunciation is in strict conformity with our analysis of the measurement of social benefit and cost of producing any increment of output.

## xii

In putting forward this solution, we have put too much reliance on the estimates regarding prices that would prevail in situations that have yet to be

<sup>1</sup> For an admirable clarification of this problem, see A. P. Lerner, *Economics of Control*, pp. 186-99.

<sup>2</sup> "Price and Output Policy of State Enterprise, Comment", *E J*, Vol LIV, p. 329.

tried. The knowledge of the demand curve is taken for granted and also the course of factor prices. These estimates are often mere guesses and subject to considerable degree of inaccuracy. But this amount of numerical imprecision cannot be helped. This is so in all problems concerning with present decisions regarding future action. 'To that incompleteness of human knowledge we must reconcile ourselves. It has existed in all forms of human society, and has always been responsible for a certain amount of loss. That the loss becomes more *explicit* in a socialist society is certainly a point in favour of socialism rather than against it.'<sup>1</sup> It is not incorrect to assume that research with regard to these problems can be carried on to a high degree of success in a planned economy with its *unique* advantage of co-ordination and integration.

Further one important point must be stressed. By advancing this solution, it is rendered evident that the question whether at any output produced by the new equipment, the consumers will offer a price which covers the average cost of production does not enter at all into the problem. The decision regarding the application of the new equipment does not depend on the prospect of making a profit or avoiding a loss. On the other hand, the guiding *social* criterion is whether the total area under the demand curve for the product of the new equipment exceeds or falls short of the sum of the areas under the relevant ranges of demand curves for goods from whose employment the factors are withdrawn.

### xiii

It may now be stated that analysis of this problem attempted so far is subject to a serious limitation. It has been confined to the fairly simple case of the application of an indivisible factor by any one firm or industry. There has been no difficulty even with regard to the case where the indivisible factor is drawn from alternative sources of employment. For in such

<sup>1</sup> A. P. Lerner, "Statics and Dynamics in Socialist Economics", *E. J.*, Vol. XLVII, p. 264.

cases the appropriate method has been to compare the areas under the relevant demand curves. But difficulty crops up once account is taken of the case where units of indivisible factors are being applied in the production of commodities whose demand conditions are interrelated. And this is the most important case since the generality of goods are either substitutes between each other or are complementary to each other. In such cases to treat the products as independent of each other in consumption would be a serious mistake.

But the whole structure of our analysis is built upon the concept of the demand *curve* and the associated concept of *surplus*. This simple structure collapses if the interdependence of demand for various commodities is taken in account. Recent developments<sup>1</sup> in the theory of value have made the importance of this interdependence so clear that 'it now seems better to stop talking about demand *curves*, and to substitute demand *functions* which will in general involve many variables, and are not susceptible of graphic representation in two or three dimensions'.<sup>2</sup> To present a solution to the problem after taking account of this most important complication is a task fitted for only the most competent economic theorists.

#### xiv

It is now possible to arrive at certain definite ideas with regard to the firm in a planned economy.

First, given a certain fixed equipment, the problem of the firm is to produce in the most *economical* manner. The task of organizing resources toward this purpose may be undertaken by the manager, irrespective of the fact whether *he* constitutes the fixed equipment or not. The payment to the organizational factor follows the same principle as the payment for any other factor that contributes to the productive activity of the firm.

<sup>1</sup> Hicks, *Value and Capital* and Henry Schultz, *The Theory and Measurement of Demand*

<sup>2</sup> Hotelling, *op. cit.*, p. 255.

The manager is only expected to act in strict accordance with the general rule laid down by the Planning Authority regarding the marginal-cost-price equality. Each firm is expected to produce up to that point (and not beyond) at which the marginal cost of production is equal to the price imposed by the Planning Authority. This simple rule serves to bring about the production of *ideal* outputs and the utilization of *ideal* inputs. An exhaustive proof of this proposition is given in Chapter III wherein it is established that this is a necessary and sufficient condition for stable equilibrium at the *ideal* scale of production.

This rule has such simplicity and force because of our strict assumption that the marginal cost of production refers only to the expense of applying the necessary doses of the variable factors in producing additional units of output. Under this condition, the output rule and the input rule are perfectly symmetrical and produce identical results. The troublesome idea of fixed cost is absent in the output rule. The equally troublesome item of the indivisible factor is absent in the input rule. Equalizing the price of product and its marginal cost means the same thing as equalizing the price of factor and the value of its marginal product.

But this symmetrical relationship between the input and output rules has not been clearly recognized by all writers on this subject and that is why there is diversity of interpretation regarding the concept of the marginal cost. To a substantial degree this confusion is due to treating marginal cost as an associated concept of total cost. It is perfectly true that the integral of the marginal cost in the relevant range of output gives the total cost of production of that output ; and marginal cost is at the rate at which total cost increases with unit increase in output. But this point is not at all necessary to bear in mind while applying the price-marginal cost rule. For marginal costs are not part of a cost which must be met. Further, the equality of price and marginal cost has nothing



to do with the realization of total costs or correct imputation of factor shares etc. The only purpose which the marginal cost is intended to serve is to bring about correct allocation of free resources and correct proportion of outputs of different products. Therefore the only interpretation of marginal cost is the cost of producing the particular unit in question.

## XV

This clears up another confusion that is associated with the concept of the marginal cost. It is often asked whether it is the short-period marginal cost or the long-period marginal cost that should be equated with price. That the question framed in this form itself is wrong becomes obvious by a careful examination of the definition of marginal cost. For, marginal cost which is the cost of producing an additional unit implies the production of the particular unit at a certain point of time. And this is all that matters. At a given moment of time different factors are applied at the margin to produce a unit output; and in the same manner marginal factors may be applied at different points of time. The appropriate marginal cost to equate to the price at any point of time is that which is incurred in the course of producing an unit increment of output at that moment of time. Marginal cost may be different at different points of time. But this offers no difficulty. All that should be aimed at is that the expected cost of producing an unit increment at any future date must equal the price expected to rule at that date.

The distinction between short-period and long-period costs persists because of the fallacious belief that the long-run marginal cost inclusive of changes in the long-run variable factors (short-term fixed factors) is greater than the shortperiod marginal cost. This is used to prove the short-coming of the price short-period marginal cost rule. A. P. Lerner has neatly demonstrated that this is not necessarily so.<sup>1</sup> But the point is that the long-run marginal

<sup>1</sup> *Economics of Control*, p. 213.

cost is not a very helpful concept. The reason is that the application of the marginal concept to long-run 'variable' factors is a matter of estimating marginal costs or marginal returns of significantly indivisible units which involves considerable numerical imprecision. This point has already been discussed.

Therefore it would be more helpful to adopt Lerner's approach and distinguish the long period from the short period by the relative ease with which adjustments can be made in the long period and which cannot be made in the short period.<sup>1</sup> Viewed in this manner the distinction between the short-run and the long-run can be reduced to the same order as the distinction between divisible and indivisible units. The marginal principle can be applied to the short-run problems, while the long-run considerations can be analysed by means of the Dupuit approach.

xvi

The marginal-cost-pricing may involve some practical complications, particularly in enterprises where the costs for increased output are negligible or zero. We have seen that in these cases price should be adjusted to the smallest marginal cost; but the smallest marginal cost may be different at different points of time. This may give rise to an intolerable fluctuation of prices and 'one might not know how much one had to pay for one's ticket in a train or tram unless one had gone to the station'. This marginal cost fluctuation depends on whether the given fixed equipment is used to optimum capacity or not. To take a favourite example, when a railway train is completely loaded and the maximum number of cars are attached, the marginal cost of carrying another passenger is the cost of running another train. But in the normal instances in which the train does not carry more than a small portion of its optimum capacity, the marginal cost is practically zero. The same thing applies to theatres. As long as there are empty seats while the show must go on, the

<sup>1</sup> *ibid.*, p. 212.

marginal cost of accommodating one more person is zero. But when the theatre is completely filled, the marginal cost of providing one more seat might mean the cost of moving into a bigger theatre. Now, to avoid a sharp increase in rates at the time when the train or the theatre is completely filled, an averaging process in the computation of rates may be resorted to, based on the probability of running another train or moving into a bigger theatre.

In cases where the available equipment is employed to the optimum capacity and it is not feasible or advisable to enlarge the equipment, the right course is to devise a way of restricting the demand to equal the maximum available supply. This is done by fixing an appropriate rental charge. Such a policy is in strict accordance with the interests of general welfare because the limited supply is made available to those who are willing to pay the most. But this rental charge should never lead to monopolistic restriction of output. In the case of railways for example the ticket should never be priced so high as to restrict travel to fewer passengers than what can comfortably be accommodated. Of course, in all such cases, allowance must be made for unpredictable variations.

xvii

In instances where the marginal cost is subject to frequent or violent fluctuations, the principle of pricing at marginal cost may as well put the consumers into an impossible position. Clearly in such cases stabilization of prices during a reasonable interval is in the general interest of the consumers. This is essential in order to facilitate planning of expenditure on the part of the consumers. If price changes were to follow the course of a 'fever chart', it would be impossible for both consumers and producers to make necessary adjustments to successively changing price positions. That is why stability of prices in an appropriate interval of time has much to be commended even though it might mean the existence of a certain amount of unused capacity or production beyond the optimum

point. Anyway, the problem here is one of balancing the gain from quick price changes against the irritation that ensues to the consumers.

In practice the problem of price fixing in such cases need offer no difficulty. The convenient procedure, as seen above, is to adopt an averaging process in computing rates providing for the probability of adding on new equipment. Having fixed a price on this basis in advance, there is no need to adhere to it if the situation calls for a revision. If at the fixed rate the trains are running with some empty seats or theatres are partially attended, the right course would be to bring down the prices to the level of marginal cost at the point of optimum capacity. Of course this implies that such price changes would not cause much inconvenience to the consumer

xviii

The next point that needs consideration is the significance of the element of *rent* in the policy of marginal-cost-pricing. It has been pointed out that the excess of marginal cost over average cost indicates the size of the *rent* and the excess of average cost over marginal cost indicates *negative* rent. This point needs some examination.<sup>1</sup>

From the viewpoint of the firm the entire expense incurred in employing various quantities of variable factors consists of necessary payments based on the strict principle of equalizing the value of the marginal product with the price of the factor.<sup>2</sup> Different *natural* units of a factor may earn different sums above what constitutes the *strictly* necessary payment. Obviously we are defining the factor in a loose sense. If all the units of a factor were perfectly homogeneous in the employment of the firm in question and elsewhere, then there would be no possibility of rent emerging anywhere. The element of rent arises because the *natural* units of a factor are heterogeneous either in regard to their service (or efficiency) in the firm under

<sup>1</sup> Lerner, *op. cit.*, p. 225

<sup>2</sup> Joan, Robinson *op. cit.*, Ch. VIII

discussion or elsewhere; if the different units are identically heterogeneous in their service inside this firm and elsewhere, then again there would be no rent). It follows that *rent* emerges as a surplus above the minimum necessary earnings because all natural units of a factor must be paid at the same rate in spite of their differing degree of efficiency so long as their employment is sought. Rent may arise either because of high efficiency of the unit in this firm and low efficiency in its next best employment or because of low efficiency in this firm and high efficiency in its next best employment

This makes it clear that so far as the firm is concerned, each unit of a factor must be paid its full price in spite of this difference in efficiency in the use of the unit inside the firm and outside. By perfect discrimination it would be possible to prevent the factors from enjoying the surplus; but this would merely mean that the surplus is transferred from the factors to the firm. This course is entirely unnecessary.

The firm has to pay the price imposed by the Planning Authority in drawing the necessary quantities of the factor. Since the units are heterogeneous, the strict application of the marginal principle is rendered difficult. The marginal concept is applicable only to small increments of a homogeneous entity. Therefore our fundamental rule of pricing at marginal cost can be invoked here to get over the difficulty. Employment of the units of the factor may be extended till the point is reached where that output is produced at which the marginal cost of production is equal to the price of the production. The application of the rule only indicates that less efficient units (that is, more efficient elsewhere) are drawn into employment, by paying a uniform price for all the units of the factor, since such a course is warranted by the demand conditions for the product as reflected by the price fixed by the Planning Authority. This analysis clears up the difficulty of heterogeneity so far as variable factors are concerned.

## xix

Attention may now be turned to the fixed factor. The problem of the fixed equipment is similar to the problem of heterogeneous units. For the term fixed factor by its very definition implies that it is incapable of alternative employment. Therefore there is no question of measuring the efficiency of the factor outside the particular employment. The transfer earnings of the factor may well nigh taken to be zero. It is in this sense that the entire earnings of the fixed factor is treated as an unnecessary earning.

We have defined the firm as a production unit wherein variable factors are applied over a given stock of fixed equipment to produce a product or products. As the demand for the product rises, the production by the firm expands. This means that more and more of variable factors are applied over a given stock of fixed equipment. By the principle of diminishing marginal productivity, it follows that the marginal cost of production will soon begin to rise. Now, if the increased output is due to the application of variable homogeneous factors drawn from a wide range of alternative employments, the rate of rise in cost would not be too great. If that is not the case, units of factors of varying degree of efficiency may have to be drawn. Higher prices have to be paid to draw increasing supply of the factors. The earlier units of the factor will be earning higher and higher rent.

Marginal cost will be rising fast. In addition to this, there is another aggravating element. The increasing application of the variable factors over a given stock of fixed equipment results in the diminution of marginal productivity at an increasing rate. This means that the marginal cost goes on rising even though there is no rise in the price of the variable factors.

With our general condition of marginal-cost-price equality, the firm may have to produce only that output which satisfies this condition for the price fixed by the Planning Authority. If at this position

the marginal cost of production is less than the average cost, then the cost of the fixed equipment is not covered by the firm. The residue left over to the fixed equipment after making full payment to the variable factors falls short of the cost of equipment. If we define the *rent* of the fixed equipment as its earnings above its cost, then in this case the fixed equipment is earnings a *negative rent*. This situation is impossible under private enterprise. In the planned economy, output at this position may continue to be produced in the general interests of the community. But in the long-run a reorganization of the firm may be necessary.

When the price fixed by the Planning Authority coincides with the minimum average cost, then the marginal-cost-price equality leads to a position where the rent to the fixed equipment is nil. This is the position under perfect competition

xx

But the more interesting position which we have recognized as unique to planned economy is a situation where the high conditions of demand warrant production under rising average costs. This is a position where the marginal cost lies above the average cost and the marginal-cost-price equality leads to the emergence of a *surplus*, a positive rent to the fixed equipment. This *rent* is measured by the difference between average cost and marginal cost multiplied by the output. The interesting point to note is that this surplus accrues entirely to the fixed equipment. For, the rent accruing to the variable factors are already included in the marginal cost curve. The surplus that the fixed equipment absorbs is an indication of the high state of demand and the scope for exploiting further potential economies. The height of the *rent* is of great significance in a planned economy

xxi

Certain striking conclusions follow from the foregoing analysis:

(i) The proposition that it is of no consequence to the general welfare if the cost of the fixed equipment

is not entirely recovered owing to the marginal-cost-pricing rule fails to bring into relief an important fact. It is that the total benefit to the community by the production of the output determined by the marginal-cost-pricing rule may exceed the entire cost of production including the cost of fixed equipment, even though marginal cost lies below average cost. This fact is not revealed because total revenue (price for the last unit sold multiplied by number of units sold) is an inadequate measure of the total benefit, which is measured by the entire area under the demand curve over the relevant range. Actually, in addition to this area, the benefit (positive or negative) arising to the other interrelated commodities by the production of this output must also be taken into account. So long as this total benefit exceeds the total cost of production, the continuation of the output at that level is worthwhile. Therefore, the true criterion is that the total net benefit (that is, total benefit minus the area under the marginal cost curve over the relevant range) must exceed the cost of fixed equipment. This criterion may be easily satisfied by the firm even though marginal cost lies below the average cost. It is only when the total benefit falls short of the cost of fixed equipment that the firm has no justification to continue its existence.

It is clear that the criterion of total revenue (price for the last unit sold multiplied by output) must be replaced by the true *social* criterion of total net benefit. That total revenue is an important *social* criterion under perfect competition is due to the fact that it realizes the twin objective of maximizing the total surplus and recovery of total cost of production through sale of output. In the absence of perfect competition, the concept of *total revenue* is misleading since at best it gives only a conservative estimate of the total benefit. It follows that the situation of a firm below the 'competitive optimum' point may be a normal feature of planned economy and yet such a position is stable and economically sound.



(ii) There is nothing to comment regarding the firm in a planned economy which is situated at the optimum point of minimum average cost. The situation is the one which is *ideal* according to the competitive norm. But such an ideal is only conspicuous by its rarity.

(iii) The situation in which a firm is producing beyond the optimum point possesses certain potentialities that are of the greatest significance in a planned economy. For, this is a position where in spite of the rising marginal cost, the demand conditions warrant production of that output. This is a clear indication of the size of the market and the *potential* demand for the product. It is essential that the size of the firm must be enlarged such that technical economies of large-scale production are utilized ; and the benefit is passed on to the community by supplying a significantly large output at a low marginal cost and hence at a low price. Further the benefit of such an expansion is not confined only to the consumption of this particular product. It has been most lucidly pointed out by Allyn A. Young that : 'Every important advance in the organization of production regardless of whether it is based upon anything which in a narrow or technical sense would be called a new "invention" or involves a fresh application of the fruits of scientific progress initiates responses elsewhere in the industrial structure which in turn have a further unsettling effect. The change becomes progressive and propagates itself in a cumulative way.'<sup>1</sup> The size of the market is the most significant pointer to the possibility of economic advancement. It is the special distinction of a planned economy which views the problem as an integrated whole, that given the 'economic endowment of the community, expansion of productive activity can be effectively undertaken in keeping with the degree of *potential* demand. This phenomenon of increasing returns has a special significance in a planned economy. For, by definition, only a centrally

<sup>1</sup> Young, op. cit., p. 533 Our discussion is mainly based on it

integrated economic system could utilize its benefits to the maximum advantage. Now, the most important among the forces reinforcing 'increasing returns' are the growth of scientific knowledge and the discovery and exploitation of new natural resources. Both these reinforcing elements can be most effectively utilized in a planned economy. But the cumulative propagation of the effects of 'increasing returns' is retarded owing to certain forces not all of which can be eliminated in a planned economy. These are, chiefly, demand for some products tending to be inelastic beyond a certain output, and supply of factors tending to be inelastic owing to natural scarcity of resources or the increasing resistance for capital accumulation. But the most important resisting element is the inability of the firm to launch upon a bigger scale of output due to the heavy initial cost involved in such an undertaking. This difficulty is a chief consideration under private enterprise but of no consideration in a planned economy. Investments could be undertaken, whatever be their size, so long as the expected net returns due to them exceeds the cost of such investments.

The importance of *potential* demand in planning production is now apparent. It is a task particularly suited to planned economy to develop the necessary vision, to look far and wide and ahead, in order to estimate correctly the degree of *potential* demand and the extent of *potential* economies that could be availed of if production of the commodity is undertaken on a scale large enough to meet the entire demand. Modern methods of production have made it clear that larger the size of the market greater the possibilities of cheapening production. According to our assumptions relating to planned economy, increased productive activity results in increased income to the individuals of the community and therefore a corresponding increase in the size of the market. Wicksteed's paradox that 'economy is the luxury of the rich' brings

out effectively the implications of the 'economies of standardization'.

xxii

Large-sized markets and large-scale methods of production firmly establish the case for standardization. When the size of the market is large, relative to the size of the firm, it is self-evident that the standardized commodity is preferred by the community. But there might exist the other possibility where the technical size of the plant is so large that the marginal cost continues to fall even at the level of output which meets the existing market demand. In that case the right course is to continue expanding output and charging a price equal to marginal cost. For, by doing so, increased consumption is made possible at a lower price. By expanding output resources are being more economically utilized. The extreme limit may be reached when the marginal cost tends zero. The good is then declared free.

The enlargement of the size of the firm to meet the growing demand is thus seen to be always in the interests of the community. This conclusion points to the uneconomic character of increasing the number of firms in order to meet a rise in demand. Such a course may be necessary to establish conditions of perfect competition. But in a planned economy it would be clearly wasteful and opposed to the interests of general welfare. It would mean from the immediate viewpoint a higher price per unit of the product (than what could have been otherwise) and from the wider viewpoint resistance to the cumulative benefit of 'increasing' returns.

xxiii

The weighty objection raised against standardization is that the satisfaction provided by a variety of choice is destroyed by means of barrack-room regimentation of production. If this is true then the force of this objection cannot be denied. But if the problem is viewed in the correct perspective of planned economy, the argument will appear to have

little substance. For standardization does not destroy variety of choice in consumption. The point that needs notice is that the two things are different. Chamberlin's criticism that product differentiation 'makes it clear that pure competition may no longer be regarded as in any sense "ideal" for purposes of welfare economics'<sup>1</sup> only strengthens our contention. The case for standardization that has been advanced in our analysis is actually in opposition to the solution offered by perfect or pure competition.

Standardization is advanced as the correct course in organizing production in the most economical manner to meet the large size of the market or to realize the full benefits of falling marginal costs. This does not rule out the existence of differentiated products (differentiated from the standardized product) in a planned economy. It is obvious that such differentiated products cannot be set against the standardized product. For, the latter is produced on such gigantic scale and sold at such phenomenally low price that there could be no competition between the two. The consumer is at liberty to spend his income in the manner he likes and if he prefers to do so, he may buy the differentiated product paying a higher price. The question whether such firms should be allowed to operate can be dealt with on independent grounds and need not be posed against the case for standardization. The fact that has to be stressed is that standardization is in social interest and such a course ought to be adopted whenever the conditions of demand or cost permit. It is under perfect competition that standardization implies absence of product differentiation. In a planned economy the two things might exist side by side without any mutual opposition.

#### xxiv

The problem of the differentiated product offers little difficulty in a planned economy. It is obvious that in any system of human society a certain amount

<sup>1</sup> Chamberlin, *op cit.*, p 214.

of differentiation in commodities and services is naturally sought and as such must exist. In any economic system that is based on the recognition of free choice, it is essential that such differentiation is fully permitted in order that the system may claim to be self-consistent. 'Commodities are differentiated partly by their very nature (without regard to demand), and partly in response to differences in buyer's tastes, preferences, locations, etc., which are as much a part of the order of things *within* any broad class of product as they are *between* one class of product and another.' Differentiation and distinction form the very essence of certain services as those of actors, singers, speakers and writers. Personal charm is in general a highly differentiated product. Retail shops cannot be massed together nor can commodities be standardized which have a natural distinction. This point is so obvious that it needs no further elaboration. But the point that needs special stress is that such differentiation which is natural might exist in a planned economy without introducing any inconsistency in the system.

What distorts this natural differentiation is the attempt on the part of the producers to exploit such differentiation for private ends of monopoly gain. That such exploitation in the modern individualist system has reached astounding proportions is too well known. But the conclusion that follows from this is rather curious for the reason that the exact opposite of it is advanced by critics of planning. In a perfectly competitive system, there can be no product differentiation. In the present-day competitive individualist systems, such distortion is thoroughly exploited for socially wrong ends. It follows that such natural product differentiation can exist in a planned economy only. For monopolistic or oligopolistic forces are totally absent and the elimination of market imperfection and the parametric price rule ensure that the demand for the product reflects the true preferences of the consumers. Further, the marginal-cost-pricing ensures

the correct allocation of resources. The problem of the differentiated product reduces itself to the ordinary problem of the firm.

The problem of firms producing differentiated products is just this. The firm is faced with a demand which is relatively restricted. As long as costs are falling output continues to expand. The firm will reach a determinate stable position of equilibrium when marginal costs are rising at the output determined by the marginal-cost-price equality. But this position might as well be one where the average cost lies above the marginal cost. The firm is acting in the social interest by continuing to produce at this point. When the installation of new firms come up, the guiding criterion will be whether the estimated net benefit due to the installation of new equipment exceeds its cost. So long as this criterion is satisfied, such investments are socially worthwhile.

Differentiation in factors or services may be of greater importance than differentiation in products. Certain services may possess such a distinctness of their own that they may as well enjoy absolute monopoly. This places such services in a position of special advantage entitling them to earn a rent whenever the demand for their services far exceeds the supply which is practically inelastic. But such earnings of *rent* are perfectly legitimate even in a planned economy since it reflects natural scarcity. Of course it may be possible for the state to take away a certain portion of this *rent* accruing to such services without in any way diminishing their scarcity. But the elimination of such *rent* is not possible so long as the product is distinguished from the rest and is scarce in relation to demand.

One more point needs consideration before closing the discussion of the firm.

While existence of *natural* product differentiation in a planned economy is perfectly justified, unnatural differentiation or unnecessary duplication or multiplication of firms producing standardized commodities

or services must be completely disallowed. For, if that is not done, the process of standardization and large-scale production is resisted. Of course, this implies that the Planning Authority may have to use a certain amount of discretion in demarcating the line between differentiated goods and goods that can be standardized. Particularly in small-scale enterprise, the existence of more than one firm when one firm could do is a common feature in the modern business economy. There are always more retail shops in some localities than are strictly necessary. And the classical example of such wasteful multiplicity is 'the familiar set of four filling stations at a street corner, where one would be able to provide all the service at a great saving in equipment as well as in the time of idle attendants for customers.'<sup>1</sup> Such wastes have to be completely eliminated in planned economy.

<sup>1</sup> Lerner, op cit, p 163

## LARGE-SCALE ENTERPRISES

## i

LARGE-SCALE enterprises constitute an important part of modern economic activity. Yet competitive economic theory has little to contribute on this problem. The reason is obvious. The nature of large-scale enterprises is such that it does not fit into the atomistic assumptions that are so much essential to establish the competitive theories. An analysis of the imperfection of the market or the forces of oligopoly has been made possible to a certain extent by extending the competitive analysis to these new problems of modern economy. But such extensions of competitive theories are not possible in the study of large-scale enterprises. For, these enterprises call for assumptions opposite to those that define competition.

Our reorientation of approach helps us in tackling the problem of large-scale enterprises without any logical difficulty. On the contrary it brings out the enormous significance of such enterprises. These enterprises constitute the most important activity in a planned economy.

## ii

Maurice Dobb<sup>1</sup> has distinguished four main types of fact on which depends the 'correctness' of decisions regarding investments of fixed capital in an individualist economy. They are: first, parallel and rival acts of investment in the same line of production or in the competing processes; second, investments in complementary processes; third, the level of savings and investment of the community as a whole; fourthly, the rate of capital accumulation over the relevant

<sup>1</sup>Maurice Dobb, *op. cit.*, pp. 278-98.



period. In the individualist economy, investment decisions are undertaken by individuals who are 'partially or wholly' ignorant of the nature of the above-mentioned four facts.

The planned economy that we have defined bears a striking contrast to the individualist system with regard to the knowledge of all these four facts. To proceed from the last fact, it has been pointed out in our Chapter I that the net rate of investment is decided by the Planning Authority and further individual savings are disallowed. This means that planned investment is always equated to *ex ante* savings. The last two facts are thus an absolute certainty in a planned economy. With regard to the first two facts, our analysis in the previous chapter has made it clear that the case for standardization and large-scale production rules out rival acts of investment in a planned economy and that the advantages of integration and disintegration are fully utilized so that complementary processes are harmoniously adjusted. That all these four facts could be correctly established is perhaps the strongest point in support of an integrated economy which is under unified central control. Investment activity can be undertaken with a correct judgement of various facts. Given the interest rate (which is governed by the net rate of investment) it is an important task of the Planning Authority to decide upon that size of enterprises which gives the maximum benefit to the community and to run the enterprises in the most economical manner.

### iii

In Chapter II reference was made to an important category of goods and services which may be provided to the consumers free of charge. It will now be established that this follows from the logic of large-scale enterprises. It is in the very nature of planned economic development that the sector of free goods will tend to be steadily increasing. The last three chapters have established the proposition that price should under no condition exceed marginal cost of

production and as long as the marginal costs are falling, expansion of output is the only course in the interests of maximum general welfare. Further we have seen that increased productive activity means increased income to the individuals (to be spent away on consumption) which in turn signifies an increasing size of the market for goods and services. As the size of the market grows, *potential* demand brings into light the *potential* economies of further enlargement of the size of the firms. With the increasing technical size of the equipment, the marginal costs tend to continue to fall even for significantly large outputs and in many such enterprises, the operating costs are actually zero. In all such instances, it is clearly in the interest of society to supply such goods and services free of cost.

That planned economy is in a unique position of advantage to launch upon large-scale enterprises is obvious. For the Planning Authority could view any economic problem with the one overriding consideration of maximizing the net benefit to the community. Further, with the advantage of unified control it can always plan out the most *economical* method of production to meet the entire demand for the product irrespective of the largeness of size. Again, only an economy which views its activity as an integrated whole could take into account the net aggregate benefit of any particular activity because such benefit may be spread far and wide, and often, over time.

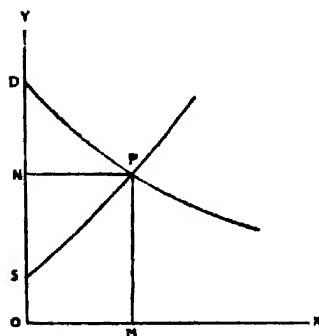
iv

We may now point out the criterion for the establishment and operation of such large-scale enterprises. These enterprises are distinguished from the one discussed in the Chapters IV and V by the fact that owing to the technically large size of the fixed equipment, production in these enterprises is subject to falling or very low (constant or rising) or zero marginal costs.

In the last chapter it was argued that the price paid for a unit of a commodity does not give an

adequate expression for the total benefit the consumers obtain by its use. For, many consumers may be willing to pay, if necessary, a price much higher than what they actually pay. Therefore, a correct measure of the total benefit is given by the aggregate of maximum price that would be paid for each individual unit of the commodity. This maximum price they are willing to pay is again capable of concrete measurement in many cases. It must at least be equal to the cost of the next alternative commodity or service which the consumer is compelled to use in the absence of this commodity or service. The maximum toll that can be extracted by a person who wants to use the bridge to cross a river is measured by what the person has to pay in engaging a ferry boat (assuming that he has no special preference for either). If  $p = f(x)$  gives the cost of such alternative uses for different units, then the total benefit obtained by the purchase

of  $x_0$  units is measured by the integral  $\int_0^{x_0} f(x) dx$ . This is the area under the arc ( $o$  to  $x_0$ ) of the demand curve for the commodity or service.



In the diagram it is indicated by the area  $DPMO$ . Since the actual amount paid by the consumers is  $PMON$ , the area  $DPN$  measures the consumers' surplus. If the marginal cost of producing the commodity is given by the function  $C = \phi(x)$  then the total cost of production for  $x_0$  units is measured by the

integral  $\int_0^{x_0} \phi(x) dx$ . The area  $SPMO$  represents the total cost of producing  $x_0$  units. But

the receipts through sales that flows to the producers is the rectangle  $PMON$ . Therefore, the area  $SPN$  measures the producers' surplus.

The total surplus by the production of  $x_0$  units is measured by  $\int_0^x f(x) dx - \int_0^x \phi(x) dx$  or in the diagram by the area  $DPS$ .

This criterion of measuring the net benefit is of great service in deciding the problems of socially worthwhile investments. But the Dupuit diagram is subject to some objections namely that the area under the demand curve may be an infinite integral, that pleasure is immeasurable and that consumers' surpluses arising out of interrelated commodities and to different individuals cannot be aggregated. Barring the first objection the rest can be conveniently answered by rejecting the demand curve and introducing the demand function for interrelated commodities. This will, in fact, give a generalized measure of the surplus.

Writing the demand function as

$$p_r = f_r(x_1, x_2, \dots, x_n) \quad r = 1, 2, \dots, n$$

the total benefit to the consumers is given by the line

$$\text{integral } \int f_1 dx_1 + f_2 dx_2 + \dots + f_n dx_n \quad (1)$$

taken from an arbitrary set of values of the  $x$ s corresponding to actual quantities consumed. Denoting the marginal cost function in similar manner,

$C_r = \phi_r(x_1, x_2, \dots, x_n)$  the line integral

$$\int \phi_1 dx_1 + \phi_2 dx_2 + \dots + \phi_n dx_n \quad (2)$$

measures the total cost of production. The total net benefit is measured by the difference between (1) and (2) which is

$$W = \int (f_1 - \phi_1) dx_1 + (f_2 - \phi_2) dx_2 + \dots + (f_n - \phi_n) dx_n$$

Writing  $f_r - \phi_r = h_r$ ,

the expression for total net benefit is given by

$$W = \int \sum h_r dx_r$$

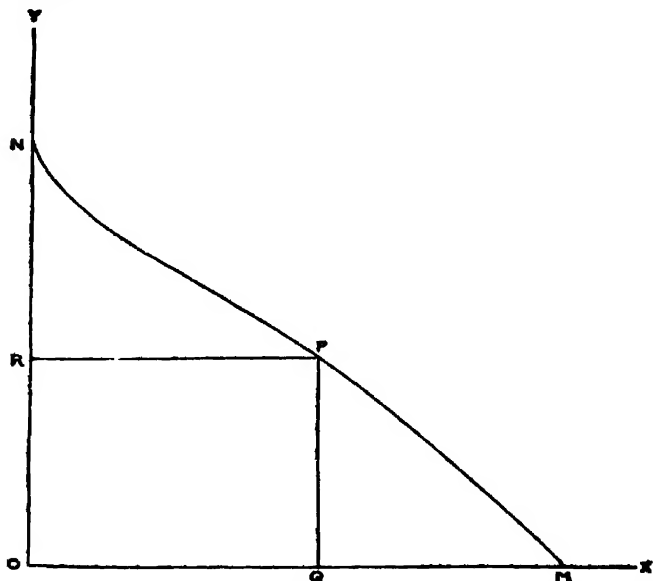
which measures the aggregate of all the surpluses arising from different commodities and accruing to different persons.

Whenever a new enterprise is undertaken, say a railway or a road, the change in  $W$  that will arise as a result of the new undertaking may be set against the cost of construction of such an enterprise. So long as the change in  $W$  exceeds the cost, such investments must be undertaken in the social interest. This is an adequate criterion and more accurate than the competitive criterion of estimating the total benefit by the total revenue which is measured by  $\sum p_r x_r$ . The difficulty rests in the proper estimation of  $W$  which can only be arrived at after a detailed study of demand conditions from all interrelated products and the consumers' surpluses of different individuals. In the case of building a road, for instance, account must be taken of the vehicular and pedestrian traffic over the entire range between the two points which the road connects and the cost of different alternative routes which may now be avoided. Taking into account all the direct and indirect effects of the introduction of the new road, the net savings in cost to the consumer has to be evaluated. If the estimated savings exceeds the cost of construction, then it is socially worthwhile to undertake the construction of the road.

#### V

The diversity between the total benefit and the total revenue criterion is very strikingly revealed in the case of large-scale enterprises. We have already pointed out that complete identity between the two criteria is only achieved under conditions of perfect competition, wherein at the point of marginal-

cost-price equality the total revenue just covers the full cost of production (including the cost of fixed equipment) and the total net benefit (the Dupuit surplus area) is at a maximum. But perfect competition implies atomistic enterprises. As we pass on to larger and larger sized enterprises, the diversity between the total benefit and total revenue becomes increasingly apparent. To illustrate this diversity,<sup>1</sup> it is convenient to take an instance of large enterprise which has negligible or practically zero operating costs. A bridge on a river is a striking illustration.



Neglecting the interrelations of the service of a bridge with other goods and service for the sake of analytical convenience we can draw the Dupuit diagram wherein the demand for the services of the bridge as indicated by the number of crossings is shown by the demand curve *NM*. The marginal cost of operating a bridge

<sup>1</sup> Hotelling, *op. cit.*, pp. 260-3.

is zero ignoring the slight wear and tear. In accordance with the propositions we have established, the bridge must be made free to the public in the interest of maximum general welfare. The total benefit to the traffic in such an instance is given by the entire area under the demand curve *NOM*. The total net benefit is at a maximum by pursuing the ideal welfare policy of pricing at marginal cost. Now, if the consideration of total revenue is applied in this instance with a view to recover the cost of construction of the bridge, then the maximum total revenue that could be obtained is given by the largest rectangle that could be inscribed inside the area under the demand curve. The height of *P* from the horizontal axis indicates the maximum toll rate. The total revenue is measured by the rectangle. The size of traffic is reduced and the benefit to the community has dwindled into the small triangular area at the top. Further, the triangular area to the right represents the net loss in benefit to the society owing to the policy of charging a toll rate. The total revenue criterion has led to a significant loss in the total net benefit to the community.

So far we are considering the use of a bridge which already exists. The diversity between the two criteria becomes all the more striking when the question of constructing a new bridge is considered. For the correct social criterion would be to launch upon the construction of the bridge if the total net benefit by its service as shown by the area under the demand curve exceeds in value the cost of construction which includes maintenance of the fixed equipment. If the total revenue criterion is applied in order to realize the cost of construction by charging a toll rate, then the relevant area of total net benefit that must be balanced against the cost is just what is included in the rectangle. If we assume a linear demand curve, then the area of the rectangle would be just half the total area. The cost of construction has to be balanced against 50 per cent of the total benefit only. Clearly such a course is absurd since

we have in view the widest general social interest.

The proposition stands strengthened that any course other than pricing at marginal cost leads to a loss in social benefit; and that general welfare is maximized only when all the costs of fixed equipment are directly met out of the public treasury.

vi

The above observations apply to all large-scale enterprises under planning. It is evident that all large-scale enterprises operating under zero or practically zero cost must make their goods and services free to the public. In this category are included roads, railroads, bridges, canals and waterworks. The argument is readily extended to other large-scale enterprises, particularly railways and public utilities such as gas, electricity, telephone and broadcasting services. For the operating costs in such enterprises are trivial and it would save the cost of accounting the revenue by such small sources if such services are declared free. It has already been mentioned that if the demand for such services exceeds the available supply and immediate expansion of the equipment is not wise or possible, then the right course is to charge an appropriate rental so that the demand may just exhaust the supply.

The system of charging rental further helps in introducing the right type of discrimination. In providing the railway service, for instance, it would greatly help in reducing the pressure on traffic during the rush hours if a rental is charged so that those for whom travel is strictly necessary need only do so. On the other hand, during hours when there is not enough traffic for the trains to run at optimum capacity, the correct course is to bring down the fare, if necessary, to zero in order that all the seats are filled. Such discrimination is of great advantage even with regard to holiday travel in particular seasons of the year. By an appropriate sliding system of rentals, it would be possible to adjust the quantity of demand to the maximum available supply at different moments of time



or with regard to travel along different railway routes. This principle might be applied even with regard to other public utilities such as electricity, gas or heating services which are also faced with an irregular demand. This type of discrimination and the device of rentals are in the interests of maximum general welfare. For the benefit is maximized when the supply of good or service is offered to those that are willing to pay the highest price. This is a correct criterion in an economic system which provides equal opportunities for all to exercise choice of consumption.

vii

The height of the *rental* is an indication of the degree of potential demand. In enterprises where the marginal cost is zero or negligibly small, the limitation for the expansion of output is given by the optimum capacity of the fixed equipment. Therefore, the correct course in the long run is the expansion of the size of the equipment. The degree of expansion, however, will depend on the criterion we have established viz. the total net benefit should exceed the cost of construction. In many instances however the *rental* persists and might rise in its height with the growth of time. This is because of natural scarcity under conditions of growing demand. The obvious instances are the *rental* for building sites, or the charge levied for water when its supply cannot be expanded. The income that is derived from such *rental* is an additional income to the public treasury. And it may be utilized in covering the cost of construction of such equipment. But the levy of rental has nothing to do with recovery of the cost of fixed equipment. It depends purely on the scarcity of supply relative to demand.

viii

The above observations on discrimination strike as a refreshing contrast to the amazing complexities of the railway and public utility rate structures of modern individualist enterprises. The loss of social interest involved in these practices is obvious. The marginal-cost-pricing rule, in addition to satisfying

the primary condition of maximizing general welfare, reduces the actual problems of such rate making to extraordinary simplicity. It has been pointed that in enterprises with zero operating costs, there will not be any rate making. In cases where discriminating rates are necessary it is always in the maximum social interest.

## ix

So far we have been considering large-sized industrial enterprises that are common to the advanced modern individualist systems and to planned economy. It has been demonstrated that planned economy makes it possible for the largest development of such enterprises and for the operation of such enterprises in the maximum social interest. But it is an additional distinction of planned economy that certain large-scale enterprises which are in their very nature ruled out of consideration in individualist countries can be undertaken to the greatest advantage of the community.

These enterprises are of a character which either involve enormous costs of fixed equipment or their benefits are spread far and wide over the community and incapable of measurement under private business principles. Obvious illustrations of the former type are the installation of the hydro-electric power plants or the construction of gigantic dams or the digging of expansive canals. There is enough evidence of the transformation that such enterprises bring about in the conditions of human existence. The Tennessee Valley Authority and on a much grander plane the U.S.S.R. are self-evident instances. The benefit of such enterprises are of a very extensive character. The immediate benefit may consist of either a remarkable improvement in agricultural production or industrialization. But the wider benefits might include the whole range of human activity, such as better conditions of living and cultural advancement. An estimation of the total benefit that such enterprises bring forth must include this entire range. Such an

estimate of total benefit far outweighs the cost involved in the construction of such enterprises.

Any attempt to recover the cost of construction of such enterprises by charging a price to the consumer would lead to a substantial reduction in social benefit. For, the cost of equipment being huge, the Planning Authority has to impose a high price in which case the only benefit to the community by its use is given by the area to the left of  $PQ$  under the demand curve in the diagram on page 103. At a high price this area is likely to be very small and the net loss to the total benefit (as indicated by the area of the triangle to the right of  $PQ$ ) may far exceed the total revenue realized by the Planning Authority (as indicated by the rectangle). In reality there would be no possible system of devising rates that would cover even the interest rates on such large investments. And yet it is very likely that the total benefit that accrues to the community may far exceed the cost of such construction (including the interest rate and maintenance charges).

It is open to planned economy to undertake such investments in the social interest because the cost of construction is directly paid out of the public treasury from the stock of capital that has been allocated for new investments. These investments have an additional advantage to the community. For these constructions are permanent additions to the capital equipment of the community and entail negligibly small, even zero, maintenance costs. Moreover the benefit that accrues to the community tends to be cumulative expansionist. The rate of obsolescence in such investments is infinitesimally small; and in effect such equipment reduces the total amount of scarce resources.

A policy of adding to the permanent stock of fixed equipment (which has no maintenance cost) is exceedingly beneficial when viewed over a period of time. A reference may be made here to the ancient Indian rulers. An important item of public

spending consisted of constructing shady avenues, building trunk roads, digging wells, tanks and canals. The Taj Mahal and Kutub Minar are other instances in point. The extent to which such construction can be undertaken depends on the amount of capital allocated for investment purposes and the rate of interest.

The other important type of large-scale enterprise whose benefit is spread far and wide consists of education, public health, amusement etc. The need for concentrating on these problems of modern societies has been pointed out by all writers on the subject of planning. Investment on such objectives results in the improvement of the capacity and character of the entire people, which again is a cumulative expansionist social benefit. The U.S.S.R. provides enough evidence of the increase in social benefit by such investments. Professor Pigou observes that: 'if it were in his power to direct his country's destiny he would take a leaf from the book of Soviet Russia and remember that the most important investment of all is investment in the health, intelligence and character of the people. To advocate "economy" in this field would under his government, be a criminal offence.' That it is the increasing responsibility of the nation to eradicate ignorance, crime, ill-health and such other evils is being increasingly realized in modern times. But the *efficient* way of attaining the necessary objective is by not charging any price for these services that are supplied. The cost of providing ordinary education to one more person is practically zero. But the cost of providing school buildings and training and maintaining the necessary staff is quite large. Yet it is in the social interest to pay the entire cost of equipment directly from the public treasury, and provide such services free or at an exceedingly small charge.

X

Our foregoing remarks lead to an altogether new perspective from which the economic problem may be

<sup>1</sup> Pigou, *Socialism Vs Capitalism*, p 138.

viewed. The competitive analysis which has formed till now the main corpus of economic theory fails to be of any help in studying this vitally important part of modern economy viz. large-scale enterprises. The enormous increase in the benefit to the community by the introduction of such enterprises is obvious. But the fact that the competitive *total revenue* criterion gives an excessively conservative and therefore faulty criterion of this total benefit has not met due recognition. The replacement of the *total revenue* criterion by the more fundamental social criterion of maximum net benefit throws open great possibilities for the introduction of these large-scale enterprises. But such replacement is possible only when the economy of the community is viewed as an integral whole. Consequently the approach to the problem must issue from *planning*.

## xi

The *total benefit* criterion raises certain interesting issues relating to the allocation of benefits and costs among the various sections of the community. For the application of this criterion implies marginal-cost pricing and meeting the cost of fixed equipment directly out of the public treasury. This problem is of a serious importance in an economy where only particular large-scale enterprises are undertaken on this principle while the general system of economy is based on the institutions of private enterprise. In such a system, it is essential that whenever a change is introduced into the system the increase in benefit from that change must be of such a size as to leave a clear surplus even after compensating by the full amount the loss that accrues to any section of the community due to that change.<sup>1</sup> In the case of large-scale enterprises based on our principle this proposition leads to endless complexities. For, while the service of such an enterprise is declared free or priced at a very low rate, the fixed cost is realized by the methods of direct taxation

<sup>1</sup> Kaldor, "Welfare Propositions in Economics," *E J.*, Vol. XXXIX, pp. 649-52. and Hicks, "Foundations of Welfare Economics", *ibid.*, pp. 696-712.

which principally falls on richer income groups and property owners. The problem then will be that the higher income groups and property owners are put to disproportionate hardship in order that the mass of the community may be benefited. Professor Hotelling has made a stimulating analysis of these complications and has arrived at striking conclusions in defence of his fundamental theorem.

This difficulty however does not confront the planned economy that we have defined here since savings are determined by the Planning Authority collectivistically and the individual money incomes are meant entirely for consumption and are distributed in a manner which provides equal opportunities of choice for all. But still the problem comes up in another way.

Individual large-scale enterprises undertaken by the state may confer benefit only to a particular section of the community though the collectivist savings is the result of the productive effort of the entire community. To cite an instance, the route in which a canal is dug naturally confers benefit primarily on the adjacent areas. The opening of new educational institutions or play grounds benefit primarily the children of the community. The question here arises whether the benefit conferred to these sections are at the expense of the rest of the community. But this difficulty arises if we assume that only these enterprises are undertaken which is clearly wrong. The state undertakes enterprises of a diverse character such as roads, railways, bridges, canals, public health activities, educational institutions, broadcasting, recreation and entertainment.

Such a variety of enterprises obviously benefits the entire community in one way or another and by the law of random distribution it may safely be assumed that a liberal policy of introducing such large-scale enterprises will confer equal benefit on the entire area of the country and over every section of the community.

## xii

The descriptive nature of the foregoing sections is intended to bring out the full significance of this sector of modern societies which calls for increasing attention. A full realization of the growing importance of large-scale enterprises would necessarily bring about a reorientation in the approach to the economic problem. The instruments of economic analysis have to be turned into the direction of the measurement of total benefit and of total cost.

## xiii

The criterion for the measurement of total benefit is given by Professor Hotelling's line integral

$$W = \int \sum h_r dx_r. \text{ To estimate the change in net}$$

benefit that arises by the introduction of any new enterprise, the change in  $W$  (that is, the change in the aggregate of the generalized surpluses) has to be calculated and set against the estimated cost of new equipment (which consists of amortization, interest rate and maintenance charges). When there are too many enterprises that satisfy this criterion, the question of proper selection arises. But this could be solved by giving priorities to enterprises that are expected to give greater benefit. If it is possible to build up a hierarchy of enterprises of a descending order regarding the magnitude of net benefit, then R. F. Kahn's device<sup>1</sup> could be made use of in fixing the *ideal* average enterprise which would give a correct indication for the necessary adjustments.

But the estimation of  $W$  will prove a difficult task compared to the total revenue criterion which is just an aggregate of the product of prices and outputs  $\sum p_r x_r$ . For, this involves the estimation of the changes in consumers' and producers' surpluses that affect the consumer and producer of all the interrelated commodities and services. And this is where economic analysis and econometric research

<sup>1</sup> R. F. Kahn, *op. cit.*, pp. 1-36.

could be of great service. 'This will call for a study of demand and cost functions by economists, statisticians, and engineers, and perhaps for a certain amount of large-scale experimentation for the sake of gaining information about these functions. The amount of such experiment and research which could easily be paid for out of the savings resulting from operation of industry in the public interest is very large indeed. Perhaps this is the way in which we shall ultimately get the materials for a scientific economics.'<sup>1</sup>

<sup>1</sup> Hotelling, *op cit*, p. 269.



## CONCLUDING NOTES

The foregoing study of the problem is based on a series of assumptions which must now be examined.

## i

First, it is assumed that the money incomes are distributed to the individuals in such a manner as to provide equal opportunities for all to exercise choice of consumption. This is a necessary welfare assumption implicitly admitted in all studies of general welfare.<sup>1</sup> In the absence of such an assumption, free choice of consumption does not bring about maximum satisfaction to all individuals. But there is a glaring inconsistency between this condition and our principle of equating the price of each variable factor to the value of its marginal product.

The input rule demands the payment of wages according to the value of marginal product of labour. Differences in productivity among diverse types of labour must evidently mean proportionate differences in their rates of reward. Any deviation from the strict application of this principle is seen to result in the diminution of total welfare. Since all income recipients contribute to the productive effort, clearly there is an inconsistency between the two assumptions which must be removed.

This difficulty however is not so serious. In cases where the full payment of the value of marginal product does not lead to a big rise in the money income (above the income allotted by the Planning Authority), it is worthwhile making full payment since small income inequalities are not likely to lead to serious distortion in the consumer's market. On the other

<sup>1</sup> Kahn, *op. cit.*, pp. 1-2.

hand there is great gain in simplifying the application of the marginal rule. But when the value of the marginal product is significantly higher than the money income allotted by the Planning Authority, a full payment of reward in money might lead to an undue pressure by any one individual or section over the entire consumers' market. The right course then would be to grant the maximum monetary income that can be allowed and provide the residual reward in terms of real benefits such as increased leisure, increased real amenities, supply of goods and services specially preferred by the individual. The funds for this purpose must be set apart in the public treasury. Evaluation of such real benefits in terms of money will be an important branch of cost accounting. But the task will not be difficult since all real benefits conferred on the individual have a market price, either of product or of factor. If such accounting devices are organized on a scale such as to include the case of every type of labour the work will be greatly simplified. This again is an economy of large-scale production.

This fund is different from the social dividend fund suggested by some writers on the subject.<sup>1</sup> They maintain that each individual must be paid a share of the social dividend (earnings due to factors other than labour) in addition to the value of his marginal product. This implies that the individual has to pay a price for practically all the goods and services produced. In planned economy the situation is likely to be different. For our principal conclusion is that all goods and services capable of being produced on a large scale must be made free to the public. Individual money incomes are meant to be expended on goods produced under conditions of rising marginal costs. The object of our fund is only to fill in the gap (through partly monetary and mostly real measures) between the money income and value of marginal product.

Oscar Lange, *op. cit.*, pp. 64-5, and Lerner, *Economics of Control*, pp. 297-8

## ii

The second assumption relates to the extremely important problem of investment and savings. It was assumed for the purposes of this study that the rate of (net) investment is fixed by the Planning Authority ; further, that the collectivist savings of the community is always equated to the rate of new investment.

This is an important power vested with the Planning Authority. The determination of the rate of investment may be based on a variety of considerations which are all closely linked up with the objectives set before the Planning Authority. The decision is obviously of a political character and arbitrary in the sense that it is not subject to the free play of economic forces. The mass of the community may give expression to their views on this question through all possible channels, but not through the market mechanism.

The Planning Authority in deciding upon the rate of investment is making a vital decision of dividing the resources of the community between satisfying current consumption and increasing productive equipment. This decision reflects the rate at which the Planning Authority intends to bring about economic advancement. It is an important assumption to make that the individuals of the community accept this decision. Once this decision is made, then its effect is seen on the interest rate which has the supreme purpose of bringing about optimum allocation of resources among different production units and of maintaining proper relationship between goods produced at different points of time. The interest rate is essentially linked up with the rate of investment. It is argued in this section that because of this important interrelationship our assumptions relating to the power of the Planning Authority and the elimination of individual savings are most helpful in regard to the application of the fundamental marginal-cost-pricing rule relating to maximum general welfare. It is further shown that the rate of investment can be altered without any disequilibrating forces being thereby generated.

Stable prices are an important requisite for effective planning of production. Frequent changes in prices make instantaneous adjustments impossible and there is the further difficulty that while some prices are flexible, others are not capable of the same degree of flexibility. According to our assumptions stabilization of the prices of products will be much more convenient since the prices of factors is not always in money terms only.

But even in the absence of net new investment the prices of products cannot remain stable owing to one important property of the production process viz. the technical transformation of present goods into future goods through the adoption of roundabout methods of production.<sup>1</sup> There is always a possibility of improving our productive equipment and this can be resorted to because the future output increases at a greater proportion than current sacrifice whenever the consumption of that output is postponed. This means that the price of the product must fall because an unit of a factor available for current production is contributing a greater amount to future output through indirect methods of production. But according to the input rule the value of the marginal product must be identical in the two uses. Therefore the increased output means lower price. Since the factor is paid according to the value of the marginal product, it follows that the price of the factor falls in the same proportion as the price of the product. The effective way of countering this price fall is by devising a money rate which is equated to the marginal yield from the postponement of current output. If the interest rate is charged on all the firms that borrow money capital to pay for factors in anticipation of their output, then the price will remain stable. But it is important for stability that the rate of interest must just equal the marginal physical yield.

When net new investment is undertaken, the

<sup>1</sup> A. P. Lerner, *Economics of Control*, Ch. XX and XXI.

value of this marginal yield directly depends on the rate of investment.

The greater the rate of investment the larger will be the sacrifice of current consumption. With the increasing investment which means increasing absorption of factors of production, there will not be a rise in prices of factors since the consumer's income is proportionately curtailed.

Resources are only shifted from one sector to the other sector. But all the same there will be an increasing cost for the investment sector relative to consumption sector since the efficiency of factors decline with successive increments. This follows from the principle of increasing technical marginal rate of substitution. The substitution of one product for another is always subject to the condition of rising marginal cost in terms of the other product. Therefore as the rate of investment increases the cost in terms of consumption goods will also rise. If the price level of consumption goods must be maintained, this means an absolute rise in the cost of new investment. This is the same thing as saying that the marginal yield from the postponement of current consumption will fall with rising rate of investment. Lerner calls this the marginal efficiency of investment (*mei*) which is 'measured by comparing the value of future marginal product with the value of the factors applied'. The *mei* is a function of the rate of investment. In order to maintain prices at a stable level, the rate of interest must be equal to *mei*. This is an important consideration which the Planning Authority has to take into account. In effect this means that before fixing the rate of interest, the rate of investment has to be appropriately fixed.

The interest rate has the important function of guiding the allocation of money capital among different productive uses; and further, of adjusting the proper price relationships at different points of time.

If the interest rate is lowered below the rate corresponding to the *mei*, there would be an increase in

demand for the factors by those investments whose *mei* was below the earlier rate and is above the present rate. If the rate is higher than the proper rate, there might be a contraction in the demand for factors since only those which have a high *mei* could afford to borrow capital. In either case price stabilization might be upset, which will dislocate the entire planning programme.

But the entire management of this problem in our planned economy is exceedingly simple. Because of our assumptions diminution in the interest rate might be immediately followed up by the corresponding increase in the rate of investment thereby reducing the money available for consumption. Similarly a rise in the interest rate might be followed up by a diminution in the rate of investment and an increase in income. Thus the total demand for factors can always be maintained at the level of full employment. Particularly when the investment programme is considered to be of urgent importance and when the community is prepared to abide by the decision of the Planning Authority, it is in the best interests of the community that both the investment and the savings are collectivized. Collectivist savings make it possible to undertake an investment programme in an orderly manner.

iii

The principal objection to the above assumption is that it denies freedom of choice to the individual with regard to the allocation of his income between consumption and savings i.e. between current and future consumption. This objection is valid since we have maintained that satisfaction of preferences forms the essential economic criterion.<sup>1</sup> The fact must be accepted that time preferences of the individuals is also an important economic criterion.

An acceptance of this objection would mean the replacement of our simple rate of investment—interest relationship by a series of complex relationships. We have seen that the rate of interest is closely related

<sup>1</sup> See Chapter I.

to the rate of investment. The other important element 'the quantity of capital' offered us no difficulty because of our assuming collectivist savings. In the absence of this assumption, the quantity of capital is determined by the individual's decisions. Given the community's propensity to save, the rate of interest must be such as to bring forth that rate of investment which just maintains full employment and does not give rise to inflation. Both these terms are of course subject to some 'conventional arbitrariness'. This means that at this interest rate the flow of investments exactly offsets the *ex ante* savings of the community at the level of full employment. If the propensity to consume rises, then the rate of interest has to be raised in order to reduce the rate of investment. If the propensity to consume declines, the interest rate has to be lowered as to attract a greater rate of investment. In this way the interest rate can always maintain the necessary equality between investment and savings. Since only individual savings are allowed, the interest rate and therefore the rate of capital accumulation reflect the time preference of the consumers. In this way the rate of capital accumulation may be based entirely on consumer's preference.

This is Oscar Lange's suggestion<sup>1</sup> to remove the 'arbitrariness' in the determination of the rate of investment. The theory no doubt has great consistency. But it is really a serious problem for planned economy to draw its investment programme entirely on the basis of expected savings on the part of individuals. To a great extent the certainty with which investment activity could be undertaken would be undermined. Changes in the community's propensity to save would mean corresponding changes in the rate of investment. This would seriously limit the realization of the objectives of investment. It would be really inconsistent with the objectives of planned economy to alter the rate of investment just to suit the individual propensities to save.<sup>2</sup>

<sup>1</sup> Oscar Lange, *Review of Economics of Socialism*, J.P.E., Vol. I, pp. 302-3.

<sup>2</sup> Maurice Dobb, "Saving and Investment in Socialist Economy", E.J., Vol. XL.

This argument is further strengthened by the fact that there is always considerable element of irrationality due to lack of sufficient knowledge on the part of the individual with regard to his discounting of future. The collectivist authority is definitely very much better equipped and therefore more competent to undertake decisions concerning future estimates.

A solution to this problem has yet to be worked out; and this is where the modern monetary theory has to be integrated with the studies of planned economy in order that an orderly planned development is rendered compatible with individual time preferences.

## iv

There has been an implicit assumption throughout our analysis regarding the efficiency of individual managers in charge of production units. To provide an adequate criterion for comparing the relative differences in efficiency among different managers is rather difficult. So far as medium-sized enterprises are concerned, if there are a number of firms producing a commodity, it might be possible to institute such a comparison by studying the surplus that accrues to them (after paying off all the factors the value of their marginal products) from the receipts obtained by producing the output on the marginal-cost-pricing rule. But such a comparison cannot be applied to managers in large-scale enterprises where there is no possibility of their being a number of firms. But there is no such measurement for managers of large-scale units in the individualist economy either. We have seen that the manager in large-scale enterprises is best viewed as performing a special service of labour. And as such our general observations regarding labour also pertain to managers. With regard to the high efficiency of labour in planned economy there is now little to be disputed. The U. S. S. R. again<sup>1</sup> provides a conclusive evidence for this statement. It has further the weighty authority of Professor Pigou.

<sup>1</sup> Maurice Dobb, *Soviet Planning and Labour*.



'In matters covered by this chapter (Incentives) socialism should be allotted *some* more marks than its rival.'<sup>1</sup>

These are the only important assumptions made in the course of the study.

v

This study has tried to put forward a plea for a reorientation in the approach to the modern economic problem. This reorientation is urgently needed owing to the radical transformation in the structure of production. The development of large-scale methods of production has been the great contribution to economic advancement in modern times. As early as 1928 the late Allyn A. Young made a thought-provoking survey of the nature and significance of 'increasing returns' and pointed at the enormous potentialities that are inherent in the modern methods of production. But this important discovery of Young has not led to much further thought owing to the excessive preoccupation on the part of economists with competitive analysis. If the interest is shifted from competitive studies to the problems of general welfare the significance of large-scale enterprises becomes at once apparent.

The body of ideas that has grown in the process of refuting the criticisms of Ludvig von Mises has brought out clearly the superiority of a planned economy over the modern individualist systems. But the most important case for planning which consists of the possibility of directing large-scale methods of production to the maximum social benefit has not been sufficiently stressed. On the contrary, the repeated insistence by A. P. Lerner on the safeguards competition is intended to provide against state monopoly is apt to belittle the importance of planning in introducing large-scale methods.

Maurice Dobb contends that: 'Actually the adjustment of supplies to welfare-yielding qualities of different objects of consumption is of such a rough order of approximation, at best, in any form of market

<sup>1</sup> A. C. Pigou *Socialism Vs. Capitalism*, p. 101.

system, as to suggest that more may be gained by sacrificing niceties of adjustment to a more rapid *general* increase than by hampering general increase by devices designed to secure a nice adjustment of whatever is produced to demand as exhibited on a market. . . . Yet when economic writers speak about the complexities of the problem of adjustments to demand, it is usually of these finer adjustments within the main groups of consumption to which they refer.<sup>1</sup> His contention is perfectly sound. Judged from the possibilities of expanding the supply of goods and services that are so much needed by the mass of the community and could be provided at so low a cost, the concern of economic analysts regarding *finer* adjustments of demand places the stress on the wrong point. The problem of reducing scarcity of general goods is more urgent than these finer adjustments.

Therefore the primary economic problem of the present time is to organize production to meet the *potential* demand by utilizing *potential* economies. That this can be done has been pointed out by Professor Hotelling with irrefutable force of logic. His revolutionary conclusions are of a very wide application and are of a nature which have to be accepted in the interests of maximum general welfare even in systems that are not subject to collectivistic planning.

This study has elaborated his ideas at length because of the conviction that they constitute the basic theory of pricing in a planned economy; and because studies on the problem so far have not brought this fact into sufficient recognition. There has been too much concentration on the free play of competitive forces within a planned economy and too little on the power of planning to eliminate artificial scarcity and to maximize general welfare.

Attention in this study is merely confined to the pricing problem, though only a part yet the basic part of the general theory of planned economy. Further

study on these lines must lead to important problems such as those relating to the process of capital accumulation and the possibility of allowing individual time preferences not to mention the allied problems of foreign trade.

Even the analysis of the pricing problem is merely restricted to the elucidation of the central proposition. The method applied is the equilibrium analysis developed by the modern value theorists. But a consistent application of their method must take into account the effects of price variations on all the interrelated products and factors. Professor Hicks has established a series of propositions relating to this problem based on the *Fundamental Slutsky Equation*.<sup>1</sup> The application of these results in the analysis of planned economy is rendered difficult to the writer owing to the fact that he has not yet clearly understood the mathematical reasoning which Professor Hicks has adopted in establishing his results.

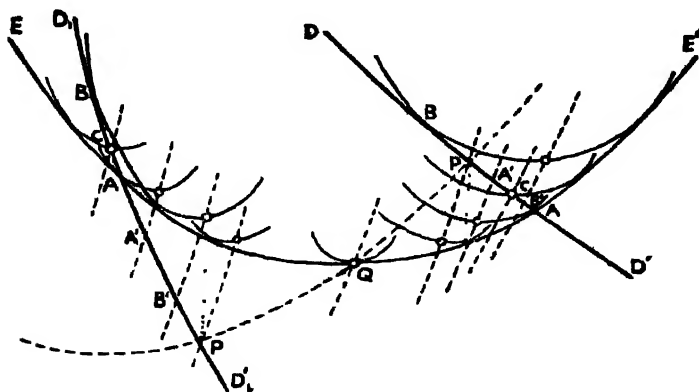
But future work on the problem exactly lies in this direction. It further involves the estimation 'of demand and cost functions by economists, statisticians, and engineers, and perhaps for a certain amount of large-scale experimentation for the sake of gaining information about these functions'.

<sup>1</sup>Hicks, *op cit.*, p. 308.

## APPENDIX

### A NOTE ON A. P. LERNER'S ENVELOPE

THE envelope curve<sup>1</sup> is interpreted as the long-term average cost curve, being an envelope to the short-term cost curves of the firm which is progressively increasing in its size. The envelope is also U shaped indicating that the long-term cost falling over a range of output reaches a minimum and then begins to rise. The long-term optimum is indicated by the minimum point  $Q$ .



Certain characteristics of this envelope need to be clearly analysed.

First, the long-term average cost is the lowest possible average cost of producing an output when the firm has adequate time to complete all the necessary adjustments. Therefore no portion of the long-term average cost curve can ever lie above any part of short-term average cost curve. It follows that the

<sup>1</sup>A. P. Lerner, "Statics and Dynamics in Socialist Economics," *E. J.*, Vol. XLVII, p. 261.

long-term average cost curve is tangent to the whole set of short-term average cost curves (i.e. their envelope) obtained by enlarging the size of the firm by infinitesimal increments.

Second, the envelope curve touches the short-term average cost curve at its minimum point only when that is a minimum point of the envelope also.

This can be proved easily as follows :

Consider a single parameter family of curves

$$y=f(x, \lambda) \quad (1)$$

In this instance  $\lambda$  denotes the size of the firm.

The equation  $y=F(x)$  of the envelope of the curves (1) is obtained by eliminating  $\lambda$  between (1) and

$$f_{\lambda}(x, \lambda)=0 \quad (2)$$

It is required to prove that if  $(x_0, y_0)$ , a common point (and therefore the point of tangency) of (1) and its envelope, is a point of extremum for (1), then it is a point of extremum for the envelope also. This is proved if it is shown that  $F'(x_0)=0$ .

Now at the common point  $(x_0, y_0)$ ,

$$F'(x_0)=f_{\lambda}(x_0, \lambda).$$

But  $f_{\lambda}(x_0, \lambda)=0$  since  $(x_0, y_0)$  is a point of extremum for (1). Therefore  $F'(x_0)=0$ .

That is, the point  $(x_0, y_0)$  is a minimum point for the envelope also.

This can as well be seen from the diagram. For the slope of the envelope is negative in its falling region and positive in its rising region whereas the slope of the short term average cost curve at its minimum point is necessarily zero. Therefore if the point of contact is a minimum point of the short-term average cost curve it must necessarily be a minimum point of the envelope also.<sup>1</sup>

This proposition is of considerable interest because it suggests that there is only one unique output for which both the long-term and the short-term costs

<sup>1</sup>G. J. Stigler, *The Theory of Price*, pp. 138-42.

are at their minimum. This is the point of optimum output produced by the optimum sized firm—the long-run ideal under perfect competition.

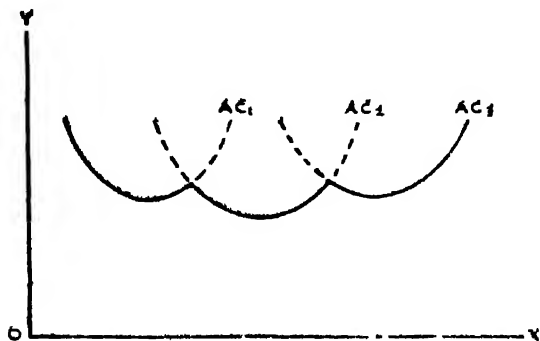
But when the long-term average cost is falling, it is more economical to construct a larger sized firm and utilize it partially rather than to construct a smaller sized firm and produce under conditions of minimum (short-term) average cost. Similarly when the long-term average cost is rising, it is more economical to operate beyond the optimum capacity a smaller sized firm rather than build a bigger sized firm and produce under conditions of minimum (short-term) average cost.

Given the demand conditions the point  $P$  shows the long-period equilibrium where price is equated both to short-term and long-term marginal costs, and the short-term and long-term average costs are equal. When the demand curve cuts the long-term marginal cost curve to the right of  $Q$ , necessarily the equilibrium position is one where the firm is producing beyond optimum capacity (i.e. under conditions of rising short-term average costs). And when the demand curve cuts the long-term marginal cost to the left of  $Q$ , the equilibrium position is one where the firm is working under excess capacity (i.e. under conditions of short term falling average costs). Both these long period equilibrium positions are in the maximum social interest.

Lerner examines in detail the case where the demand curve cuts the long-period marginal cost curve to the right of  $Q$  and only makes a passing mention of the second case where the demand curve cuts the cost curve to the left of  $Q$ . This relative emphasis given to the former case perhaps flows from the supposition that relative to the conditions of demand it is more common for the firm to be small sized and to operate beyond the point of optimum capacity. But from the viewpoint of planned economy, it would be more appropriate to examine

in detail the equilibrium position to the left of  $Q$ . For under modern technological conditions, it is open to the firm provided there is no restriction on its expansion, to utilize all the available large-scale economies in order to produce the output in the most economical manner. This is further facilitated by the fact that planning implies elimination of unnecessary rival and parallel acts of investment so that *potential* economies of expansion may always be weighed against *potential* demand. Therefore for products which have a significantly large potential demand it would be more appropriate to suppose that the long-term equilibrium position is reached to the left of the point  $Q$ .

If the type of the product is such that relative to the state of demand, the technical conditions of production permit only a small sized firm, then the long-term equilibrium would be to the right of  $Q$ . This is likely only in cases where products are of a distinguished or special nature such that economies of large scale are not sufficiently available or worthwhile.



In examining this envelope we have implicitly assumed that it is correct to admit the possibility of varying the size of the firm by infinitesimal

increments. Only on this assumption could we postulate a smooth continuous envelope curve. While this assumption is permissible for an analytical presentation of the problem, it is certainly not warranted by the facts of the economic world. For technical conditions of production do not permit the possibility of infinitesimal variations in the size of the fixed equipment. The fixed equipment is available only in discrete sizes, and expansion of the firm is subject to discontinuous variation. In such instances the envelope breaks down in solving the long-term average cost and marginal cost problems.

The point may be illustrated by the above diagram:

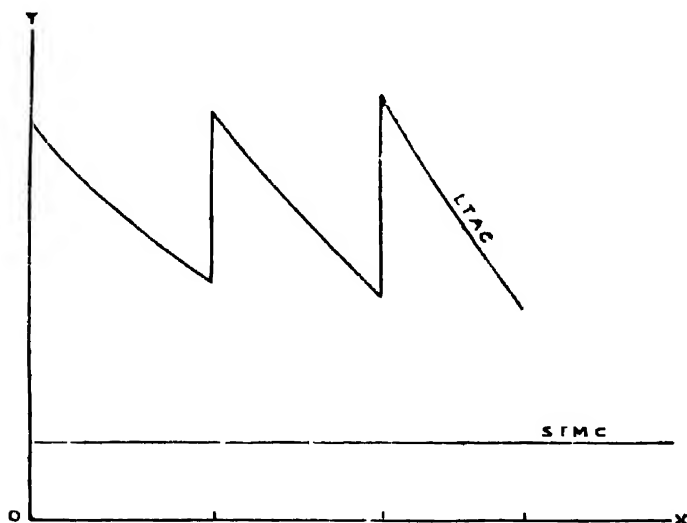
Suppose that over the relevant range of output the fixed equipment of the firm is available only in three discrete sizes. In that case the long-term average cost is indicated by the solid line which contains kinks at points of movement from one size of the fixed equipment to the next. The corresponding long-term marginal cost curve entails substantial discontinuities. Such long-term average and marginal curves are of little help in economic analysis.

In enterprises where the cost of the fixed equipment is enormous but operating costs are negligibly small and constant, this type of discontinuity becomes all the more significant. Consider, for example, the possibility of expanding a railway service *given* the permanent way. It may be assumed that the short-term marginal cost is small and constant. The possibility of expanding the service to meet the increasing traffic adequately depends *inter alia* on the technical size of the rolling stock which can be utilized only in discrete quantities. The long-term average cost conditions of providing the service would be as shown in the following diagram.

While the short-term marginal cost is constant the short and long-term average cost is indicated by the saw-tooth curve and the upward jerky movements



of the curve refer to the points of movement from one unit of the fixed equipment to another. These points are reached when it is technically impossible to provide an additional unit of service with the existing fixed equipment. The long-term marginal cost curve will have no finite values corresponding to these kinky points. Obviously the long-run criterion of equating price to long-term marginal cost has little meaning in this case.



But this fact need not be disconcerting. The only condition for correct allocation of resources is that the price of the product must be equated to the marginal cost of production. And the appropriate marginal cost to equate at any moment of time is that which is incurred in the course of producing an unit increment of output at that moment of time. All the same in all such cases, to avoid a sharp increase

in fare at the time when the train is filled to capacity, an averaging process may be applied in the computation of rates, based on the probability of having to run an additional train.

The distinction between the long period and short period appears to rest on the relative ease with which adjustments can be made in the long-term and which cannot be made in the short-term. Viewed in this manner the distinction reduces to the same order as the distinction between divisible and indivisible units. The marginal principle can be conveniently applied to divisible units and the problem of indivisible units can be tackled on the lines of Dupuit and Hotelling.



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